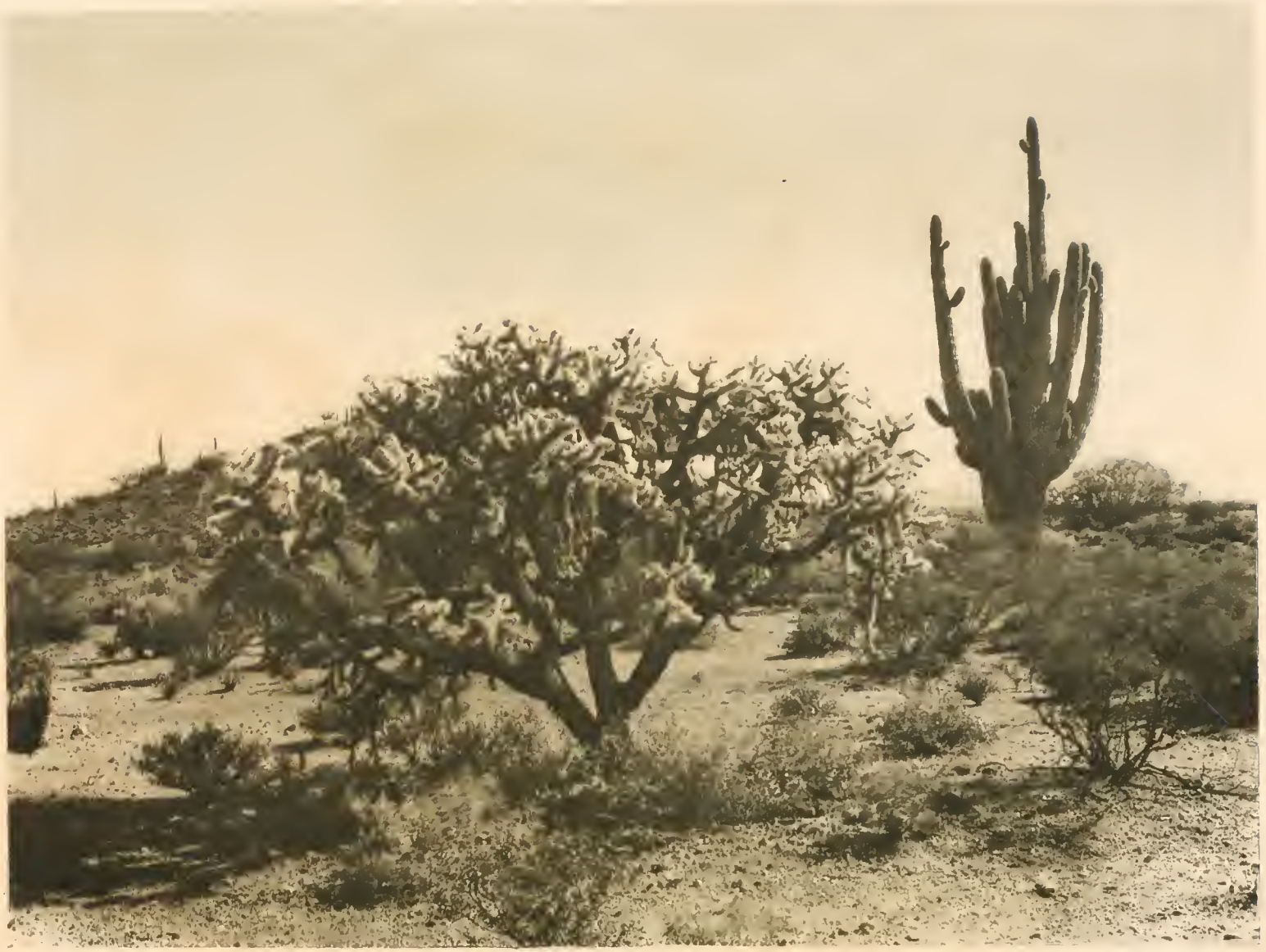

A Cactus Desert in Arizona. Photograph by D. T. McDougal.

THE CACTACEAE

DESCRIPTIONS AND ILLUSTRATIONS OF PLANTS OF THE CACTUS FAMILY

BY

N. L. BRITTON AND J. N. ROSE

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THE CACTACEAE

Descriptions and Illustrations of Plants of the Cactus Family

THE CACTACEAE.

INTRODUCTION.

The writers began field, greenhouse, and herbarium studies of the Cactaceae in 1904 and in the years following they made studies and collections over wide areas in the United States, Mexico, and the West Indies. It was first intended that these should be followed by a general description of the North American species only, but a plan for a more complete investigation of the family was proposed by Dr. D. T. MacDougal in January 1911. This was approved by the trustees of the Carnegie Institution of Washington at its next regular meeting and a grant was made to cover the expenses of such an investigation. Dr. Rose was given temporary leave of absence from his position as Associate Curator in charge of the Division of Plants, United States National Museum, and became a Research Associate in the Carnegie Institution of Washington, with William R. Fitch and Paul G. Russell as assistants; Dr. Britton, Director-in-Chief of the New York Botanical Garden, was appointed an honorary Research Associate, while R. S. Williams, of the New York Botanical Garden, was detailed to select and preserve the specimens for illustration. Work under this new arrangement was begun January 15, 1912, and thus several lines of investigation were undertaken in a comprehensive way.

1. *Reexamination of type specimens and of all original descriptions:* This was necessary because descriptions had been incorrectly interpreted, plants had been wrongly identified, and the errors perpetuated; thus the published geographical distribution of many species was faulty and conclusions based on such data were unreliable. Not only had specific names been transferred to plants to which they did not belong, but generic names were interchanged and the laws of priority ignored. Many valid species, too, had dropped out of collections and out of current literature and had to be restored.

2. *Assembling of large collections for greenhouse and herbarium use:* Extensive greenhouse facilities were furnished by the New York Botanical Garden and the United States Department of Agriculture, while the herbaria and libraries of the United States National Museum and of the New York Botanical Garden furnished the bases for the researches. The New York Botanical Garden has also cooperated in contributing funds in aid of the field operations, in clerical work, and a large number of the illustrations used have been made there, the paintings and line drawings mostly by Miss Mary E. Eaton.

3. *Extensive field operations in the arid parts of both Americas:* Many of these deserts are almost inaccessible, while the plants are bulky and if not handled carefully are easily destroyed. Many plants require several years to mature, in some cases many years to flower in cultivation. Through these explorations were obtained the living material for the greenhouse collections and for exchange purposes, as well as herbarium material for permanent preservation. Of much importance, also, were field observations upon the plants as individuals, their form, habit, habitat, and their relations to other species.

Early in 1912 Dr. Rose went to Europe to study the collections there and to arrange for exchanges with various botanical institutions having collections of these plants. He spent considerable time at London, mainly at the Royal Botanic Gardens, Kew, where through the courtesy of the Director, Sir David Prain, he was able to examine the greenhouse, illustrative, and herbarium material for which this institution has long been famed. The collection at the British Museum of Natural History and that of the Linnaean Society of London were examined. At Paris he studied the collections at the Natural History Museum, many of which have historic interest; one of his interesting discoveries there was that the *Pereskia bleo*, collected by Baron Friedrich Alexander von Humboldt in Colombia, is a very different species from the plant which for nearly a century has been passing in our collections and literature under that name. He also visited the famous botanical garden of the late Sir Thomas Hanbury, at La Mortola, Italy, and through the courtesy of Lady Hanbury was given every possible facility for the study of this collection; Mr. Alwin Berger, who was then curator in charge, had brought together one of the most extensive representations of this family to be found growing in the open in any place in the world. Here in the delightful climate of the Riviera were grown many species which were apparently just as much at home as they would have been in their desert habitats. Dr. Rose also visited Rome, Naples, Venice, and Florence, where he saw smaller collections in parks and private gardens. At Munich he examined certain types in the Royal Botanical Museum, then under the charge of Dr. L. Radlkofer, and saw some interesting species in the Royal Botanical Garden then being organized by Dr. K. Goebel. At Berlin he examined the herbarium and living specimens in the Berlin Botanical Garden, through the courtesy of Dr. A. Engler, and the West Indian collection through the courtesy of Dr. I. Urban. He then went to Halle and saw L. Quehl's collection of mammillarias; to Erfurt, where he saw the Haage and Schmidt, and Haage Jr. collections; to Darmstadt to see the Botanical Garden under Dr. J. A. Purpus; and to Antwerp to see DeLaet's private collection.

In 1913 Dr. Britton and Dr. Rose visited the West Indies. Dr. Britton, who was accompanied by Mrs. E. G. Britton, Miss D. W. Marble, and Dr. J. A. Shafer, collected on St. Thomas and the other Virgin Islands, Porto Rico, and Curaçao. At the latter island he rediscovered the very rare *Cactus mammillaris*, which had not been in cultivation for many years. Dr. Rose, who was accompanied by William R. Fitch and Paul G. Russell, also stopped at St. Thomas, and collected on St. Croix, St. Christopher, Antigua, and Santo Domingo.

In 1914 and 1915 Dr. Britton again visited Porto Rico and, assisted by Mr. John F. Cowell and Mr. Stewardson Brown, explored the entire southwestern arid coast and the small islands Desecheo, Mona, and Muertos.

In 1914 Dr. Rose went to the west coast of South America, making short stops at Jamaica and Panama. He made extensive collections in central and southern Peru, central Bolivia, and northern and central Chile. At Santiago, Chile, he examined a number of Philippi's types in the National Museum and obtained some rare specimens from the Botanical Garden through the courtesy of Johannes Söhrens.

In 1915 Dr. Rose, accompanied by Paul G. Russell, visited Brazil and Argentina on the east coast of South America, collecting extensively in the semiarid parts of Bahia, Brazil, and in the region about Rio de Janeiro, so rich in epiphytic cacti. In the deserts about Mendoza and Córdoba, in Argentina, collections were also made. Here he also arranged for exchanges with the leading botanists and collectors. The following persons have made valuable contributions from the regions visited: Dr. Leo Zehntner, Joazeiro, Brazil; Dr. Alberto Löfgren, Rio de Janeiro, Brazil; Dr. Carlos Spegazzini, La Plata, Argentina; Dr. Cristóbal M. Hicken, Buenos Aires, Argentina; and Dr. Carlos S. Reed, Mendoza, Argentina.

In October and November 1916, Dr. Rose, accompanied by Mrs. Rose, visited Curaçao and Venezuela, studying especially the cactus deserts about La Guaira and Puerto Cabello. A number of photographs were taken by Mrs. Rose.

While *en route* for Venezuela, arrangements were made with Mr. Harold G. Foss to make a collection of cacti at Coro, Venezuela. Among the specimens obtained were species not found farther east in Venezuela, so far as known.

In 1916 Dr. Britton, assisted by Mr. Percy Wilson, studied the cacti of Havana and Matanzas Provinces and those of the Isle of Pines, Cuba.

In 1918 Dr. Rose, assisted by George Rose, visited Ecuador on behalf of the United States Department of Agriculture, aided by the Gray Herbarium of Harvard University and the New York Botanical Garden; about thirty rare or little-known species were obtained.

Through the expenditure of about $2,400, contributed by Dr. Britton, a very important collection of cacti was made by Dr. J. A. Shafer during a six months' exploration from November 1916 to April 1917 of the desert regions of northwestern Argentina, southeastern Bolivia, northeastern Argentina, and adjacent Uruguay and Paraguay. Fortunately, for the purposes of this work, this collection was brought back to New York by Dr. Shafer in time for the information yielded by it and by his field observations to be used in the manuscript. It has given us first-hand information concerning over 120 species of cacti as to which we have previously known little.

There are still a few cactus regions which ought to be explored, but the following summary will show the wide field from which we have obtained information.

Our field investigations have covered practically all the cactus deserts of Mexico. The most important of these are the vicinities of Tehuacán and Tomellín, the plains of San Luis Potosí, the chalky hills surrounding Ixmiquilpan, the lava fields in the Valley of Mexico and above Cuernavaca, the deserts of Querétaro, the west coast of Mexico extending from the United States border to Acaponeta, and the seacoasts and islands of Lower California. Other regions in Mexico containing cacti, but not in such great abundance as the foregoing, are those about Pachuca, Oaxaca City, Mitla, Jalapa, Iguala, Chihuahua City, and Guadalajara. All the work in Mexico, however, was done prior to 1912, for, owing to political disturbances, no field work there has been feasible since that time.

In the United States our work has extended over the cactus regions of Florida, Texas, New Mexico, Arizona, southern California, western Kansas, and southeastern Colorado.

In the West Indies we have explored all of the Greater Antilles, the Bahamas, the Virgin Islands, St. Christopher, Antigua, Barbados, and Curaçao.

In South America our field study included the most important deserts of Peru, Bolivia, and Chile, and parts of Brazil, Venezuela, Ecuador, and Argentina. The cactus deserts of South America are so extensive and so remote from one another that it was possible to visit only a part of them in the four seasons allowed for their exploration.

Among many enthusiastic volunteers whose contributions of specimens and data have greatly supplemented our own collections and field studies, the following deserve especial mention:

Mr. Henry Pittier has made valuable sendings from Colombia, Venezuela, Panama, Costa Rica, and Mexico; Mr. O. F. Cook, from Guatemala and Peru; Mr. G. N. Collins, the late Federico Eichlam, Mr. R. H. Peters, Mr. C. C. Deam, Mrs. T. D. A. Cockerell, Baron H. von Türckheim, and the late Professor W. A. Kellerman have sent important collections from Guatemala; Mr. A. Tonduz, Mr. Otón Jiménez, Dr. A. Alfaro, Mr. C. Wercklé, and Mr. Alfred Brade, local collectors and naturalists in Costa Rica, have sent much good material from their country; Mr. William R. Maxon has sent new and rare material from Costa Rica, Guatemala, and Cuba; Professor C. Conzatti and his son, Professor Hugo Conzatti, Dr. C. A. Purpus, Dr. Elswood Chaffey, Mrs. Irene Vera, M. Albert de Lautreppe, and the late Mr. E. A. H. Tays have sent us many interesting specimens from Mexico; Mr. W. E. Safford made a valuable collection in Mexico in 1907; E. W. Nelson and E. A. Goldman, who have collected so extensively in Mexico and the Southwest, have obtained many herbarium and living specimens for our use; Mrs. Gaillard, who lived at Panama several years while the late Colonel D. D. Gaillard was a member of the Isthmian Canal Commission, collected interesting cacti, including *Epiphyllum gaillardae;* the late Dr. H. E. Hasse sent specimens from southern California and Arizona; C. R. Orcutt, the well-known cactus fancier, has aided us in many ways besides sending us specimens from his collections; Dr. R. E. Kunze has frequently sent specimens, especially from Arizona; General Timothy E. Wilcox, for whom *Wilcoxia* was named, has sent us specimens from the Southwest, while his son, Dr. G. B. Wilcox, contributed several sendings from the west coast of Mexico and Guatemala; Dr. D. T. MacDougal has sent many specimens from all over the Southwest, especially from Mexico, Arizona, and southern California; he has made several excursions into remote deserts, which have yielded interesting results, and has contributed many excellent photographs, quite a number of which are reproduced in this report (Plate 1, etc.). Professor F. E. Lloyd, while located in Arizona and in Zacatecas, Mexico, made large collections of living, herbarium, and formalin material, often accompanied by valuable field notes, sketches, and photographs. Dr. Forrest Shreve has sent specimens, especially from northern Arizona and Mr. W. H. Long from New Mexico; Mr. S. B. Parish and Mr. W. T. Schaller have furnished interesting specimens and valuable notes on southern California species; Professor J. J. Thornber has made valuable contributions of material and notes from Arizona; Mr. M. E. Jones, Mr. I. Tidestrom, Mr. Thomas H.

Kearney, and Professor A. O. Garrett have all sent specimens from Utah; Professor T. D. A. Cockerell and Mr. Merritt Cary have sent specimens from Colorado; Dr. P. A. Rydberg has brought many specimens from the Rocky Mountain region; Messrs. Paul C. Standley, E. O. Wooton, Vernon Bailey, and H. L. Shantz have sent specimens from the southwestern United States; Brother León, of the Colegio de la Salle, Havana, and Dr. Juan T. Roig, of the Estación Agronómica, Santiago de las Vegas, Cuba, have contributed Cuban specimens, and Dr. J. A. Shafer has collected widely in Cuba; Mr. William Harris, of Hope Gardens, Jamaica, has collected for us in Jamaica; Dr. John K. Small has obtained collections from nearly all over the southeastern United States, aided by Mr. Charles Deering. Dr. Henry H. Rusby and Dr. Francis W. Pennell have contributed plants and specimens from Colombia, collected in 1917 and 1918. Mr. Frederick V. Coville, of the United States Department of Agriculture, has made many valuable suggestions during the progress of the investigation.

In our studies we have also had use of the cacti of the following American collections: Herbarium of the Missouri Botanical Garden at St. Louis; the Gray Herbarium of Harvard University; the Rocky Mountain Herbarium at Laramie, Wyoming; the collection of the United States Department of Agriculture; the herbarium of the University of California, especially the Brandegee collection; and the herbarium of the Field Museum of Natural History.

The types of the new species described in this work are deposited in the herbaria of the New York Botanical Garden and the United States National Museum, unless otherwise indicated.

In greenhouse collections many kinds of cacti grow very slowly, and flower only after many years' cultivation. We have a number of plants of this kind from various parts of America. It is hoped that some of them may bloom during the period of publication of this book and thus enable us to include them in an appendix.

FIG. 1.—Pereskia pereskia. Grown as a hedge.

Order CACTALES.

Perennial, succulent plants, various in habit, mostly very spiny, characterized by specialized organs termed areoles. Leaves usually none, except in *Pereskia* and *Pereskiopsis*, where they are large and flat but fleshy, and in *Opuntia* and its relatives, where they are usually much reduced and mostly caducous, terete, or subulate. Spines very various in size, form, arrangement, and color, sometimes with definite sheaths. The areoles are peculiar and complex organs, situated in the axils of leaves when leaves are present, and bearing the branches, flowers, spines, glochids, hairs, or glands; in some genera two kinds of areoles occur, either distinct or united by a groove. Flowers usually perfect, either regular or irregular, usually solitary but sometimes clustered, sometimes borne in a specialized terminal dense inflorescence called a cephalium; perianth-tube none, or large and long, the limb spreading or erect, short or elongated, the lobes few or numerous, often intergrading in shape and color, but sometimes sharply differentiated into sepals and petals; stamens commonly numerous, elongated or short, sometimes clustered in series, the filaments usually borne on the throat of the perianth, the small oblong anthers 2-celled; style one, terminal, short or elongated; stigma-lobes 2 to many, usually slender; ovary 1-celled, distinct, or immersed in a branch or forming a part of a branch; ovules numerous. Fruit a berry, often juicy and sometimes edible, sometimes dry, in one species described as capsular and dehiscing by an operculum, in others opening by a basal pore. Seeds various; cotyledons two, accumbent, sometimes minute knobs, often broad or elongated; endosperm little or copious; radicle terete.

The order consists of the following family only:

Family CACTACEAE Lindley, Nat. Syst. ed. 2. 53. 1836.

Characters of the order as given above. The family is composed of three tribes.

Key to Tribes.

Leaves broad, flat; glochids wanting; flowers stalked (sometimes short-stalked), often clustered ..... 1. *Pereskieae*
Leaves (except in *Pereskiopsis*) terete or subterete, usually small, often wanting on the vegetative parts; flowers sessile.
  Areoles with glochids (except in *Maihuenia*); vegetative parts bearing leaves, which are usually small and fugacious; flowers rotate (petals erect in *Nopalea*) ..... 2. *Opuntieae*
  Areoles without glochids; usually no leaves on the vegetative parts (except cotyledonary); flowers with definite tubes (except *Rhipsalis*) ..... 3. *Cereeae*

Tribe 1. PERESKIEAE.

Stems and foliage as in other dicotyledonous plants; inflorescence in some species compound; flowers more or less stalked, their parts all distinct; glochids wanting; ovule with short funicle; testa of seed thin, brittle.

The genus *Pereskia*, the only representative of this tribe, is, on account of its similarity to other woody flowering plants, considered the nearest cactus relative to the other families, but this relationship is in all cases remote.

The nearest generic relatives of *Pereskia* in the cactus family are doubtless the following:

Pereskiopsis, some of whose species were first assigned to the genus *Pereskia*, but they have different foliage and the areoles often bear glochids.

Opuntia, whose species have leaves, though much reduced and usually caducous, otherwise very different; but some of the species of *Opuntia* were first referred to *Pereskia*.

Maihuenia (two of whose species have only recently been taken out of *Pereskia*), whose seeds are similar but the areoles lack glochids, otherwise very different.

This tribe has a wide geographic distribution, but is found wild only in the tropics.

1. PERESKIA (Plumier) Miller, Gard. Dict. Abr. ed. 4. 1754.

Leafy trees, shrubs, or sometimes clambering vines, branching and resembling other woody plants; spines in pairs or in clusters in the axils of the leaves, neither sheathed nor barbed; glochids (found only in the Opuntieae) wanting; leaves alternate, broad, flat, deciduous, or somewhat fleshy; flowers solitary, corymbose, or in panicles, terminal or axillary, wheel-shaped; stamens numerous; style single; stigma-lobes linear; seeds black, glossy, with a brittle shell, the embryo strongly curved; the cotyledons leafy; seedlings without spines.

Type species: *Cactus pereskia* Linnaeus.

In 1898 about 25 names had been proposed in *Pereskia*, but, in his monograph published that year, Karl Schumann accepted only 11 species. Several new ones have been proposed since the publication of Schumann's monograph.

The species are native in Mexico, the West Indies, Central America, and South America. Some of the species are much used as stocks for growing the various forms of *Zygocactus*, *Epiphyllum*, and other cacti requiring this treatment; *P. pereskia* is most used and *P. grandifolia* next. Several species are widely cultivated as ornamentals in tropical regions; they do not flower freely under glass in northern latitudes. All species studied by us in the living state grow readily from cuttings.

The typical species seems to have been first introduced into Europe from the West Indies in the latter part of the sixteenth century. A straight-spined species was first described and figured by L. Plukenet in 1696, who called it a portulaca, and the next year by Commerson as an apple (*Malus*). In 1703 C. Plumier described the genus *Pereskia*, basing it upon a single species. The genus was repeatedly recognized by Linnaeus in his earlier publications, and by some pre-Linnaean botanists, but in 1753 Linnaeus merged it into *Cactus* along with a number of other old and well-established genera; but it was retained by Philip Miller in 1754 in the fourth edition (abridged) of his Gardeners' Dictionary and has since been generally recognized as a genus by botanical and horticultural authors.

The name is variously spelled *Peirescia*, *Peireskia*, *Perescia*, and *Pereskia*.

Named for Nicolas Claude Fabry de Peirese (1580–1637).

Key to Species.

Climbing vines, the twigs with a short pair of reflexed spines from each areole, the stem with acicular spines (Series 1. Typicae) ..... 1. *P. pereskia*

Shrub or trees with slender straight spines (Series 2. Grandifoliae).

- Petals toothed or fimbriate.
  - Petals somewhat toothed ..... 2. *P. autumnalis*
  - Petals fimbriate.
    - Species from Mexico; ovary turbinate ..... 3. *P. lychnidiflora*
    - Species from Costa Rica; ovary pyriform ..... 4. *P. nicoyana*
- Petals entire, at least not fimbriate.
  - Branches and leaves very easily detached ..... 5. *P. zehntneri*
  - Branches and leaves not easily detached.
    - Axils of sepals bearing long hairs and bristles.
      - Leaves lanceolate ..... 6. *P. sacharosa*
      - Leaves orbicular ..... 7. *P. moorei*
    - Axils of sepals not bearing long hairs and bristles.
      - Flowers white ..... 8. *P. weberiana*
      - Flowers not white.
        - Petals yellow.
          - Leaves lanceolate to oblong or obovate ..... 9. *P. guamacho*
          - Leaves orbicular or broadly ovate ..... 10. *P. colombiana*
        - Petals red or purple.
          - Spines few or none ..... 11. *P. tampicana*
          - Very spiny, at least on old branches.
            - Flowers terminal.
              - Flowers panicled.
                - Fruit naked, broadly truncate ..... 12. *P. bleo*
                - Fruit leaf-bearing, not truncate.
                  - Leaves of ovary cuneate at base ..... 13. *P. bahiensis*
                  - Leaves of ovary broad at base ..... 14. *P. grandifolia*
              - Flowers solitary ..... 15. *P. zinniaeflora*
            - Flowers usually axillary and solitary.
              - Leaves 1 cm. long or longer, obtuse or acute.
                - Flowers 2 to 5 together, 1 cm. long; South American species ..... 16. *P. horrida*
                - Flowers solitary, 1.5 cm. long; petals elliptic-obovate; Cuban species ..... 17. *P. cubensis*
              - Leaves emarginate, 1 cm. long or less, petals obovate ..... 18. *P. portulacifolia*

Affinity unknown ..... 19. *P. conzattii*

Series 1. TYPICAE.

Consists of only the typical species, which is widely distributed, and much cultivated throughout tropical America. Schumann regarded it as a subgenus under the name *Eupereskia*.

1. Pereskia pereskia (Linnaeus) Karsten, Deutsch. Flora 888. 1882.

Cactus pereskia Linnaeus, Sp. Pl. 469. 1753.
Pereskia aculeata Miller, Gard. Dict. ed. 8. 1768.
Cactus lucidus Salisbury, Prodr. 349. 1796.
Pereskia longispina Haworth, Syn. Pl. Succ. 178. 1812.
Pereskia aculeata longispina De Candolle, Prodr. 3: 475. 1828.
Pereskia fragrans Lemaire, Hort. Univ. 2: 40. 1841.
Pereskia undulata Lemaire, Illustr. Hort. 5: Misc. 11. 1858.
Pereskia foetens Spegazzini in Weingart, Monatsschr. Kakteenk. 14: 134. 1904.
Pereskia godseffiana Sander, Gard. Chron. III. 43: 257. 1908.

Shrub, at first erect, but the branches often long, clambering, and forming vines 3 to 10 meters long; spines on lower part of stem solitary or 2 or 3 together, slender and straight; spines in the axils of the leaves paired, rarely in threes, short, recurved; leaves short-petioled, lanceolate to oblong, or ovate, short-acuminate at the apex, tapering or rounded at base, 7 cm. long or less; flowers in panicles or corymbs, white, pale yellow, or pinkish, 2.5 to 4.5 cm. broad; ovary leafy and often spiny; fruit light yellow, 1.5 to 2 cm. in diameter, when mature quite smooth; seeds black, somewhat flattened, 4 to 5 mm. in diameter; hilum basal, circular, depressed, or crater-shaped.

The plant and fruit have several common names, one of which, blade apple, was in use as early as 1697. Lemon vine, Barbados gooseberry, and West Indian gooseberry are three others, with various French and Dutch modifications. In Argentina it is called sacharosa, according to Sir Joseph Hooker (Curtis's Bot. Mag. 116: pl. 7147), but this name is properly applied only to the *P. sacharosa* of Grisebach, native of Argentina, a distinct species, which Hooker thought identical with this.

The berries are eaten throughout the West Indies and the leaves are used as a pot herb in Brazil. The species was in cultivation in the Royal Gardens of Hampton Court in 1696 and has been at Kew ever since its establishment in 1760, but did not flower until 1889. In Washington we have one plant among a dozen which flowers abundantly each year; three plants at New York bloom annually.

In tropical America the plant climbs over walls, rocks, and trees, and at flowering time is covered with showy, fragrant blossoms, followed by beautiful clusters of yellow berries. In La Plata it is grown sometimes for hedges (see fig. 1), but its strong, almost offensive odor makes it objectionable for growing near habitations.

Type locality: Tropical America.

Distribution: West Indies and along the east and north coasts of South America; found also in Florida and Mexico, but perhaps only as an escape; widely grown for its fruit.

This species consists of several races, differing in shape and size of the leaves and in color of the flowers. One of these races, with ovate-orbicular leaves rounded at the base, had heretofore been known to us only in cultivation, but in October 1916, while collecting in Venezuela, Dr. Rose found this broad-leafed form common in the coastal thickets near Puerto Cabello.

Pereskia lanceolata (Förster, Handb. Cact. 513. 1846), *P. acardia* Parmentier (Pfeiffer, Enum. Cact. 176. 1837), and *P. brasiliensis* Pfeiffer (Enum. Cact. 176. 1837), usually referred as synonyms of *P. aculeata*, were not formally published in the places above cited.

The following varieties, based on the shape of the leaves, are recorded under *P. aculeata: lanceolata* Pfeiffer (Enum. Cact. 176. 1837); *latifolia* Salm-Dyck (Hort. Dyck. 202. 1834, name only); *rotundifolia* Pfeiffer (Enum. Cact. 176. 1837); *rotunda* (Suppl. Dict. Gard. Nicholson 589. 1901) is perhaps the same as *rotundifolia*.

Pereskia aculeata rubescens Pfeiffer (Enum. Cact. 176. 1837) is described with glaucous-green leaves above, tinged with red beneath.

Near the last belongs *Pereskia godseffiana*, described as a sport in the Gardeners' Chronicle in 1908. It is a very attractive greenhouse plant, often forming a round,

M E Eaton del.

1. Flowering branch of *Pereskia pereskia*.
2, 3. Fruits of the same.
4. Leafy branch of *Pereskia sacharosa*.
5. Proliferous fruit of the same.

(All natural size.)

densely branched bush, but is sometimes grown as a climber, as a basket plant, or in the form of a pyramid. It is especially distinguished by the rich coloration of the leaves, which are variously mottled or blotched above with crimson, apricot-yellow, and green, but of a uniform purplish crimson beneath. We have seen this form in the New York Botanical Garden, where it is grown only as a bush. It was exhibited first at Ghent, Belgium, in 1908, and is supposed to have originated in Queensland, Australia.

Illustrations: Stand. Cycl. Hort. Bailey 5: pl. 87; Blühende Kakteen 2: pl. 86; Bot. Reg. 23: pl. 1928; Curtis's Bot. Mag. 116: pl. 7147; Gard. Chron. III. 29: f. 61; Plumier, Nov. Pl. Amer. pl. 26, in part; Safford, Ann. Rep. Smiths. Inst. 1908: f. 10; Schumann, Gesamtb.

FIG. 2.—Pereskia autumnalis.

Kakteen f. 109, all as *P. aculeata*. Descourtilz, Fl. Med. Antill. ed. 2. 4: pl. 294, as Cactier à Fruits Feuilles; Vellozo, Fl. Flum. 5: pl. 26, as *Cactus pereskia;* Gard. Chron. III. 43: f. 114, as *P. godseffiana*.

Plate II, figure 1, of this volume is a flowering branch of a plant at the New York Botanical Garden obtained from M. Simon, of St. Ouen, Paris, France, in 1901; figure 2, fruit of same plant; figure 3, fruit of another plant. Text-figure 1, from a photograph taken by Paul G. Russell at La Plata, Argentina, in September 1915, shows the plant used as a hedge.

Series 2. GRANDIFOLIAE.

In this series we include 18 species, all tropical American, both continental and insular. Schumann, regarding the series as a subgenus, applied to it the name *Ahoplocarpus*.

2. Pereskia autumnalis (Eichlam) Rose, Contr. U. S. Nat. Herb. 12: 399. 1909.

Pereskiopsis autumnalis Eichlam, Monatsschr. Kakteenk. 19: 22. 1909.

Tree, 6 to 9 meters high, with a large, round, much branched top, the trunk usually very definite and 40 cm. or more in diameter, often covered with a formidable array of spines; young branches

cherry-brown, smooth; spines in the axils of the leaves usually solitary, sometimes in threes, long and slender, 3 to 4 cm., rarely 16 cm. long; leaves thickish, oblong to orbicular, 4 to 8 cm. long, rounded or somewhat narrowed at base, mucronately tipped; flowers solitary, near the tops of the branches, short-peduncled; ovary covered with leafy scales; flowers 4 to 5 cm. broad; petals entire, orange-colored; stamens numerous; fruit globular, 4 to 5 cm. in diameter, fleshy, glabrous, bearing small, scattered leaves, these naked in the axils; seeds black, glossy, 4 mm. long.

Type locality: In Guatemala.

Distribution: Widely distributed in Guatemala, usually at an altitude of 120 to 300 meters; but we do not know of its occurrence elsewhere.

FIG. 3.—Pereskia autumnalis. ×0.5.

FIG. 4.—Pereskia lychnidiflora.

The plant, so far as we know, has no common name and no use is made of its fruit.

Illustrations: Contr. U. S. Nat. Herb. **12**: pl. 52 to 54; Safford, Ann. Rep. Smiths. Inst. **1908**: pl. 10, f. 1; Monatsschr. Kakteenk. **21**: 37, the last as *Pereskiopsis autumnalis*.

Text-figures 2 and 3 are copied from the above-cited illustrations. The original photographs were obtained by O. F. Cook in Guatemala.

3. Pereskia lychnidiflora De Candolle, Prodr. 3: 475. 1828.

Evidently a tree or shrub; branches cylindric, woody; leaves large, 4 to 7 cm. long, oval to oblong, pointed, rounded at base, sessile, fleshy, with a prominent midvein; axils of leaves each bearing a stout spine 2 to 5 cm. long and several long hairs; flowers large, 6 cm. broad, solitary, borne at the ends of short, stout branches; petals broadly cuneate, laciniate at the apex; ovary turbinate, bearing small leaves.

Type locality: In Mexico.

Distribution: Mexico.

This species was described by De Candolle from Mociño and Sessé's drawing, but it has never been collected since, so far as we can learn. Its large flowers with laciniate petals must make this a very striking species and it is surprising that it has not been rediscovered. Schumann thought it might be the same as *P. nicoyana* of Costa Rica, but a study of recent Costa Rican collections indicates that the species are distinct. The measurements given in the description are taken from De Candolle's plate, and may require some modification. *Cactus fimbriatus* Mociño and Sessé (De Candolle, Prodr. 3:475. 1828) was published only as a synonym of this species.

Illustrations: Mém. Mus. Hist. Nat. Paris 17: pl. 18; Förster, Handb. Cact. ed. 2. 1003. f. 136; Safford, Ann. Rep. Smiths. Inst. 1908: 545. f. 11.

Text-figure 4 is copied from the first illustration above cited.

4. **Pereskia nicoyana** Weber, Bull. Mus. Hist. Nat. Paris 8: 468. 1902.

Tree, usually about 8 meters high; branches rigid, stout, covered with smooth brown bark; spines wanting or single, long (4 cm. long), stout and porrect; leaves in fascicles on old branches, but alternate on young shoots, lanceolate or oblanceolate, subsessile, the lateral veins almost parallel and some-

FIG. 5.—Pereskia nicoyana. ×0.6.

FIG. 6.—Pereskia zehntneri. ×0.6.

times seeming to come from the base, acute, bright green, and somewhat shining; axils of the young leaves containing long white hairs; petals reddish yellow, fimbriate; ovary pyriform, bearing 8 to 12 spreading leaves, except the uppermost ones, which are much smaller and connivent.

Type locality: Gulf of Nicoya, Costa Rica.

Distribution: Costa Rica.

The spines, hairs in the axils of the leaves, and fimbriate petals indicate a relationship to the little-known *P. lychnidiflora*.

Mr. H. Pittier informs us that this species is common in the open coastal forests along the Pacific side of Costa Rica. The plant illustrated by Mr. Pittier, referred to below, has a long, slender trunk and is very spiny.

According to Mr. W. E. Safford, it has long, slender spines and the habit of the Osage orange, and is used as a hedge plant in Costa Rica, where it is known as matéare or puipute.

Illustration: Pittier, Pl. Usuales Costa Rica pl. 2.

Text-figure 5 was drawn from a plant obtained by Mr. C. Wercklé at San José, Costa Rica, in 1912.

5. **Pereskia (?) zehntneri** sp. nov.

Shrub, 2 to 3 meters high, with a central erect trunk, very spiny; branches numerous, horizontal, usually in whorls, sometimes as many as 10 in a whorl; branches terete, green, fleshy, very easily detached from the stem; leaves stiff, fleshy, numerous, small, 2 to 4 cm. long, ovate to orbicular, acute, standing at right angles to the branches; areoles large, filled with short white wool and numerous slender white spines; flowers at tops of branches, large, 7 to 8 cm. broad, bright red, appearing in November; petals broad, retuse; ovary borne in the upper end of the branch, very narrow, 3 to 4 cm. long, bearing the usual leaves, areoles, and spines of the branches.

Collected by Dr. Leo Zehntner (Nos. 567 and 630, type) November 15 and 16, 1912, at Bom Jesus da Lapa, Bahia, Brazil, on the Rio São Francisco.

This is a very rare plant and seen in only one locality, in soil of a peculiar chalky formation. Living plants were taken by Dr. Zehntner to the Horto Florestal, Joazeiro, Brazil, where they grew well, and whence Dr. Rose obtained specimens in 1915 which were shipped to the United States under No. 19722.

The plant is known in Bahia under the name quiabento. It is probably not a true *Pereskia;* it suggests in its habit and foliage some of the Mexican species of *Pereskiopsis*, but it may represent a distinct genus.

Text-figures 6 and 7 are from the type plant above cited.

FIG. 7.—Pereskia zehntneri. Photograph by Paul G. Russell.

6. **Pereskia sacharosa** Grisebach, Abh. Ges. Wiss. Göttingen 24: 141. 1879.

Pereskia amapola Weber, Dict. Hort. Bois 938. 1898.
Pereskia argentina Weber, Dict. Hort. Bois 938. 1898.

Small tree or shrub, 6 to 8 meters high; branches green and smooth, but in age becoming yellowish or light brown; leaves lanceolate to oblanceolate, 8 to 12 cm. long, cuneate at base, more or less pointed at apex; young areole with 1 to 3 spines, the longest 5 cm. long, the others when present not over half as long, all acicular and dark in age; older areoles often with 6 or more spines; pedicels sometimes 10 mm. long; flowers in terminal clusters, either white or rose-colored and very showy, 8 cm. broad, open at midday; sepals about 8, 1 or 2 petal-like, the others scale-like, the outer sepals and upper scales bearing long hairs; petals 8, rose-colored, oblanceolate, 3 cm. long; stamens free from the petals, numerous, unequal, erect; filaments, style, and stigma-lobes white; ovules borne on the lower part of ovary; ovary bearing small leaves, their axils filled with short wool and occasionally bearing a spine; fruit hard, 2.5 to 4 cm. in diameter, more or less tapering at base, many-seeded, leafless or nearly so, sometimes proliferous.

Type locality: Cobos, Oran, Argentina.

Distribution: Paraguay and Argentina.

Schumann (Gesamtb. Kakteen 765. 1898) gives *Opuntia sacharosa* Grisebach as a synonym of this species, but erroneously, since it was never taken up by Grisebach as an *Opuntia*. The Index Kewensis refers this species to *P. aculeata*, doubtless following Hooker's references in Curtis's Botanical Magazine for 1890 in regard to Argentine plants, which even then were little known.

The common name of this plant in Argentina is sacharosa. It is sometimes used as a hedge plant.

Plate 11, figure 4, represents a leafy branch of a plant given to the New York Botanical Garden by Frank Weinberg in 1903; figure 5 shows its fruit.

7. **Pereskia moorei** sp. nov.

A much branched shrub about 1 meter high, covered with brown bark; branches stout; leaves orbicular or obovate-oblong, rounded or apiculate at the apex, somewhat cuneately narrowed at the base, thick and fleshy, 4 to 8 cm. long, 3.5 to 6 cm. wide; areoles suborbicular, 4.5 mm. in diameter, the wool gray; spines at each areole mostly 2 to 4, very unequal, the longest 7.5 cm. long or less, ashy gray, blackish toward the apex; flowers purplish red, about 4.5 cm. long; ovary few-leafed, its leaves obovate-oblong, 2.5 to 3 cm. long, bearing 1 to 3 black spines about 5 mm. long in the axils; sepals narrowly oblong-obovate, bluntly acute, 2.5 cm. long, bearing long bristles in their axils; petals obovate, obtuse, 3.5 cm. long, rose-colored; stamens about 2 cm. long; areoles on the ovary large, filled with a mass of short, white wool and bearing an occasional short spine; fruit not known.

FIG. 8.—Pereskia moorei. ×0.66.

FIG. 9.—Pereskia guamacho.

Described from the specimen preserved in the herbarium of the British Museum of Natural History collected at Corumba, Brazil, by Spencer Moore, No. 955, who has kindly furnished us with data for this description, together with a sketch of the type specimen. Specimens were also collected at Corumba by F. C. Hoehne in 1908, No. 4863, who supposed it to be *P. sacharosa*.

Figure 8 is from a photograph of an herbarium specimen from Matto Grosso, Brazil, received from F. C. Hoehne in 1915.

8. **Pereskia weberiana** Schumann, Gesamtb. Kakteen 762. 1898.

Shrubby, much branched, glabrous, 2 to 3 meters high, the slender round branches about 3 mm. thick; leaves ovate to elliptic, about 3 cm. long and 2 cm. wide, sessile, acute at the apex, obtuse at the base; areoles circular, slightly elevated, the wool short, whitish, fading brown; spines 3 to 6 at the lower areoles, solitary at the upper, 2 cm. long or less, terete, acicular, yellow or horn-colored; flowers clustered, white, about 1 cm. long or less; ovary about 2 mm. long, bearing a few white, woolly areoles; outer segments of the perianth triangular, acute, woolly at the axils, the inner spatulate to obovate; stamens a little longer than the petals; stigma-lobes 3 or 4, erect.

Type locality: Tunari Mountains,* Bolivia, at 1,400 meters altitude.

Distribution: Bolivia, known only from the type locality.

This species is said to flower in May.

The description has been drawn from a cotype in the herbarium of the New York Botanical Garden, and from Professor Schumann's original account of the species in his Gesamtbeschreibung der Kakteen, p. 762. Dr. Kuntze obtained the specimens during his botanical exploration of Bolivia in 1892. The species was named, but not described, by Professor Schumann in Dr. Kuntze's Revisio Genera Plantarum (3^2: 107. 1893).

The material preserved is too imperfect to enable us to give an illustration of this plant.

FIG. 10.—Pereskia guamacho. ×0.8.

9. Pereskia guamacho Weber, Diet. Hort. Bois 938. 1898.

Plant very spiny, usually a small shrub 1 to 3 meters high, but often a tree 10 meters high with a trunk up to 4 dm. in diameter and 3 meters long or more below the much branched top; areoles rather prominent, especially in age often standing out like small knobs on the branches, filled with brown felt, at first usually with only 1 to 4 spines along with a few short accessory ones, but in age often with 20 spines or more; spines somewhat divaricate, rigid, brown, the longer ones often 4 cm. long; leaves on young branches solitary, but on old wood growing in fascicles, acute, lanceolate to ovate or obovate with cuneate bases, usually about 3 cm. long, but sometimes 5 to 9 cm. long by 3 to 6 cm. broad, fleshy; flowers probably solitary, but so thickly set along the branches as to appear almost spicate, sessile, bright yellow, 4 cm. broad; ovary covered with small, lanceolate-acuminate leaves, these hairy in the axils; stamens numerous; fruit globular, about 2 cm. in diameter, becoming naked, said to be orange-colored and edible; seeds black, flattened, 4 mm. broad.

Type locality: Basin of the Orinoco, Venezuela.

Distribution: Venezuela mainland and on Margarita Island.

This plant is very common not only in the flat land along the coast of Venezuela but also in the mountains. It is also widely grown in and about yards, for the leaves are supposed to have medicinal properties, and when properly grown as a hedge it forms a

*Tunari Mountains, just northwest of Cochabamba, Bolivia, about at the site of Sacaba.

most formidable protection. In the grazing regions of the country and along railways where wire fencing is employed, the trunks and larger branches are used for posts and smaller branches for intervening supports; these posts and stays, however, do not die, but in time grow to considerable size.

Although the wood, especially the branches, has little strength or endurance, it is used somewhat for making hanging baskets for orchids. It is known everywhere as guamacho, which was taken by Weber as the specific name for the plant.

Figures 9 and 10 are from photographs taken by Mr. H. Pittier at Carácas, Venezuela, in 1913.

10. Pereskia colombiana sp. nov.

A tree, 6 to 11 meters high, or sometimes smaller and shrub-like; main stem covered with clusters of slender spines, 2.5 to 7 cm. long; branches glabrous, either bearing spines or naked, covered with light-brown bark; areoles small, woolly; leaves oblong to obliquely orbicular, short-petioled, unarmed at base, often broad above, usually acute, probably fleshy, glabrous, 4 cm. long or less; flowers bright yellow, opening about midday, borne on the old wood, solitary, sessile, 4 cm. broad; ovary covered with small ovate, acute leaves, these hairy in the axils; sepals oblong, obtuse, about 1 cm. long, entire on the margins; stamens numerous; fruit not known.

Fig. 11.—Pereskia colombiana. ×0.5.

Collected by Herbert H. Smith at low altitudes near Santa Marta, Colombia, in April, 1898 to 1905 (No. 1886, type), and from the same locality by Justin Goudot in 1844, and by Francis W. Pennell in 1918 (No. 4765).

Mr. Smith remarks that the leaves are deciduous in March or April, and that the tree is leafless when in bloom in the spring.

Figure 11 is copied from a drawing of an herbarium specimen collected by Herbert H. Smith at Ronda, Santa Marta, Colombia.

11. Pereskia tampicana Weber, Dict. Hort. Bois 939. 1898.

Shrub; branches often without spines or the spines several, needle like, black, 2 to 3 cm. long; areoles globular, appearing as knobs along the stem; leaves about 5 cm. long, petioled; flowers 2.5 cm. long; petals entire, rose-colored.

Type locality: Near Tampico, Mexico.

Distribution: Eastern Mexico, but known only from the type locality.

P. tampicana is not well known and has been reported only from Tampico, Mexico. Dr. E. Palmer made a careful search for it some years ago at the type locality, but in vain. In 1912 Dr. Rose examined the two small specimens of the species preserved in the herbarium of the Royal Botanical Garden of Berlin, and is convinced that it is a *Pereskia* and not a *Pereskiopsis*.

Pereskia rosea A. Dietrich (Allg. Gartenz. 19: 153. 1851; *Opuntia rosea* Schumann, Gesamtb. Kakteen 764. 1898) is supposed to have come from Mexico, but we have not been able to identify it; Schumann refers to it in a note under *P. tampicana*. Here he also takes up *Pereskia zinniaeflora* De Candolle (Prodr. 3: 475. 1828). Both these specific names are much older than *P. tampicana*, and should either of them be found identical with it, the name *P. tampicana* would be rejected.

12. Pereskia bleo (HBK.) De Candolle, Prodr. 3: 475. 1828.

Cactus bleo Humboldt, Bonpland, and Kunth, Nov. Gen. et Sp. 6: 69. 1823.
Pereskia panamensis Weber, Dict. Hort. Bois 739. 1898.

A tree, sometimes 7 meters high; trunk 10 cm. in diameter or less, when old becoming naked, but young shoots often bear large fascicles of spines (sometimes 25 or more); young branches red, leafy, its spines in fascicles of 5 and 6, but young shoots often bear but 1 to 4, black, acicular, up to 2.5 cm.

long; leaves thin, oblong to oblanceolate, 16 to 21 cm. long, 4 to 5.5 cm. wide, acuminate, cuneate at base, tapering into petioles 2 to 3.5 cm. long; areoles circular, bearing when young a little wool, but soon becoming naked; calyx turbinate, somewhat angled, naked, with linear deciduous sepals; petals 12 to 15, rose-colored, obovate, 3.5 cm. long; style longer than the stamens, red, thick; stigma-lobes 5 to 7; ovary depressed; fruit yellow, truncate, 5 to 6 cm. long; seeds 6 mm. long, black, shining.

Type locality: Near Badillas, on the Magdalena River, Colombia, South America.

Distribution: Northwestern South America and throughout Panama.

This species was collected by Bonpland during Humboldt's trip through the New World and was described and published by Kunth in 1823. Dr. Rose examined two of the original specimens in the herbarium of the Museum of Natural History at Paris, one being the specimen given by Bonpland and the other the specimen in the Kunth Herbarium,

FIG. 12.—Pereskia bleo.

which is kept distinct from the general herbarium. The only other representatives of this species from South America which we have seen are a specimen in the herbarium of the same museum, which was collected by Justin Goudot in Colombia in 1844, and one collected in 1852, by I. F. Holton at San Juancito, Colombia, preserved in the Torrey Herbarium and one recently brought by Francis W. Pennell from Boca Verde, Rio Sinu, Colombia.

Heretofore *Pereskia bleo* has been considered one of the most common species, for many living collections as well as herbaria contain many specimens under that name; the plant which has been known as *P. bleo*, however, is *P. grandifolia* Haworth, now known to be a native of Brazil and not found wild in Colombia.

Since determining that the so-called *Pereskia bleo* of our gardens and of Brazil is not the true *P. bleo* of Humboldt, we have become convinced that *P. panamensis* Weber is the same as *P. bleo;* Mr. Pittier's exhaustive exploration of Panama has strengthened our conclusions, for he has traced this species as far south as the Colombian border. Humboldt's plant came from northern Colombia.

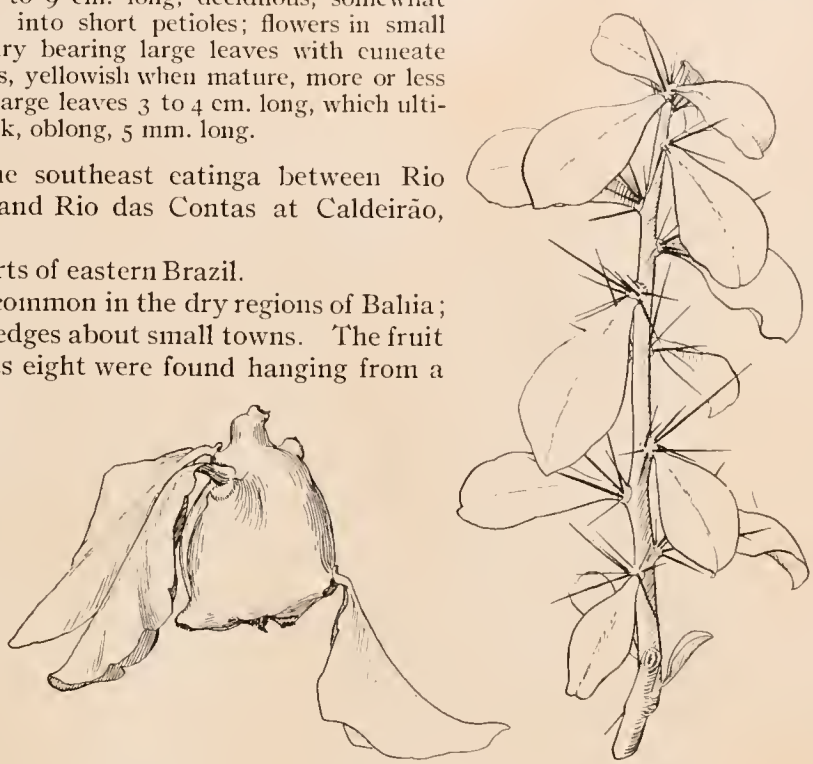
In Panama the plant is known under the name ñajú de Culebra.

Illustrations: All illustrations referred to this species which we have examined are cited under *P. grandifolia*.

Figure 12 is from a photograph taken by Henry Pittier, near Chepo, Panama, October 30, 1911.

13. Pereskia bahiensis Gürke, Monatsschr. Kakteenk. 18: 86. 1908.

Shrub or tree, sometimes 8 meters high, with a more or less definite trunk, sometimes 1 meter or more long and 1.5 to 2 dm. in diameter, and a large, rounded, much branched top; spines on new growth wanting, but on old wood 5 to 40 at an areole, some of them 5 to 9 cm. long; young branches green; leaves lanceolate, 6 to 9 cm. long, deciduous, somewhat pointed, narrowed at base into short petioles; flowers in small panicles, rose-colored; ovary bearing large leaves with cuneate bases; fruit often proliferous, yellowish when mature, more or less irregularly angled, bearing large leaves 3 to 4 cm. long, which ultimately fall away; seeds black, oblong, 5 mm. long.



Figs. 13, 14.—Pereskia bahiensis. ×0.5.

Type locality: In the southeast catinga between Rio Paraguaçu at Tambury and Rio das Contas at Caldeirão, Bahia, Brazil.

Distribution: Dry parts of eastern Brazil.

This species is very common in the dry regions of Bahia; and is often planted for hedges about small towns. The fruit is proliferous; as many as eight were found hanging from a single peduncle; it is said to be edible, but while half-ripe is very astringent. The perfect fruits can seldom be found, because the birds peck into them for the large black seeds.

Called in Brazil, according to Dr. Leo Zehntner, Iniabanto, Espinha de São Antonio, and Flor de Cêra. He also says: "I think Iniabanto is the best and ought to be generalized. It is derived from Iniabo = Okra = *Hibiscus esculentus*, without doubt because the leaves of the pereskias are sometimes eaten by people, giving a mucilaginous dish like that of the Hibiscus fruit."

Illustration: Monatsschr. Kakteenk. 18: 87.

Figure 13 is from a specimen, preserved in formalin, collected by J. N. Rose near Machado Portello, Bahia, Brazil, in June 1915; figure 14 is from a plant from the same place; figure 15 is from a photograph obtained by J. N. Rose at Barrinha, Bahia, in June 1915.

14. Pereskia grandifolia Haworth, Suppl. Pl. Succ. 85. 1819.

Cactus rosa Vellozo, Fl. Flum. 206. 1825.
Pereskia ochnacarpa Miquel, Bull. Sci. Phys. Nat. Neerl. 48. 1838.

Tree or shrub, 2 to 5 meters high, usually with a definite, very spiny, woody trunk up to 1 dm. in diameter, the branches fleshy, glabrous, elongated, usually with 1 or 2 acicular spines at the areoles; leaves oblong, obtuse or acute, somewhat narrowed at base, 8 to 15 cm. long; petioles short; inflorescence terminal, usually few-flowered; 3.5 to 4 cm. broad; sepals green; petals rose-colored, sometimes white; filaments red; style and stigma-lobes white; ovary leaf-bearing; fruit described as large, pear-shaped, many-seeded; seeds black.

Type locality: In Brazil.

Distribution: Brazil, widely planted and subspontaneous throughout the West Indies.

The plant is extensively used for hedges in tropical America. It is planted by pushing cuttings into the ground, its spiny stems soon forming a capital barrier.

Illustrations: Vellozo, Fl. Flum. 5: pl. 27, as *Cactus rosa*. Amer. Garden 11: 462; Blühende Kakteen 3: 137; Curtis's Bot. Mag. 63: pl. 3478; Cycl. Amer. Hort. Bailey 1: f. 309; Dict. Hort. Bois f. 678; Edwards's Bot. Mag. 17: pl. 1473; Engler and Prantl, Pflanzenfam. 3^{6a}: f. 71; Gard. Chron. III. 20: f. 75; Karsten, Deutsch. Fl. 887. f. 9; Martius, Fl. Bras. 4^{2}: pl. 63; Pfeiffer and Otto, Abbild. Beschr. Cact. 1: pl. 30; Reichenbach, Fl. Exot. pl. 328, all as *Pereskia bleo*.

FIG. 15.—Pereskia bahiensis. Photograph by Paul G. Russell.

Plate III, figure 1, represents a flowering branch of a plant obtained by N. L. Britton on St. Christopher in 1901. Figure 16 is from a photograph of the plant used as a hedge near Rio de Janeiro, Brazil.

15. Pereskia zinniaeflora De Candolle, Prodr. 3: 475. 1828.

Shrub; leaves oval to oblong, 2 to 4 cm. long, acuminate, cuneate at base; spines on young branches 1 or 2 at an areole, on old branches 4 or 5, all short, less than 1 cm. long; flowers broad, 5 cm. wide, rose-red; petals entire, obtuse or retuse; style and stamens very short; ovary truncate, bearing small, stalked leaves.

Type locality: In Mexico.

Distribution: Mexico.

Nicholson associates this species with *Pereskia bleo*, that is, *P. grandifolia*, but the relationship is not close. The measurements of the flower given above are taken from

M. E. Eaton del.

1. Flowering branch of *Pereskia grandifolia*. 2. Leafy branch of *Pereskiopsis chapistle*.
3. Leafy branch of *Pereskiopsis pititache*. (All natural size.)

De Candolle's plate cited below, and may not be quite correct. This species, so far as we are aware, has not been again collected.

Cactus zinniaeflora Mociño and Sessé (De Candolle, Prodr. 3: 475. 1828) was given as a synonym.

Illustrations: Förster, Handb. Cact. ed. 2. f. 135; Mém. Mus. Hist. Nat. Paris 17: pl. 17; Rümpler, Sukkulenten f. 127; Suppl. Dict. Gard. Nicholson f. 624.

Figure 17 is a copy of the second illustration above cited.

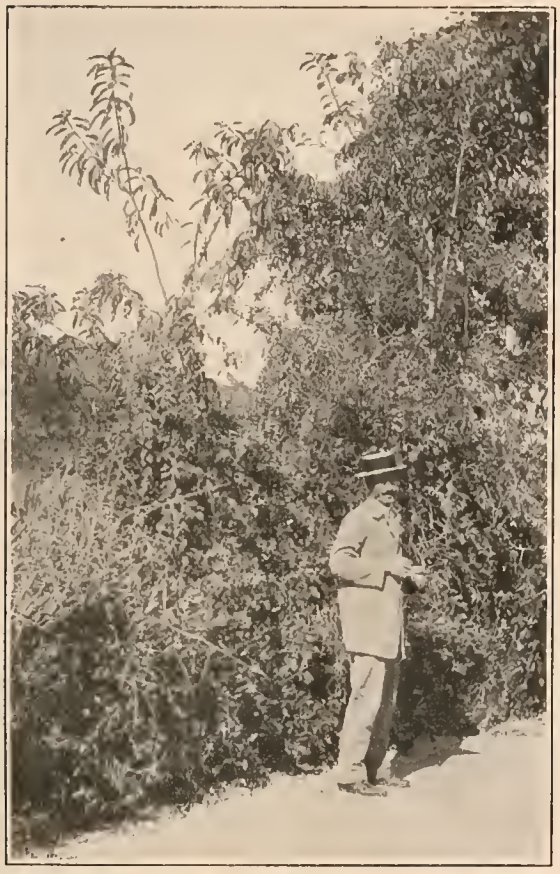


FIG. 16.—Pereskia grandifolia. Exposed branches are shown above the other foliage.

FIG. 17.—Pereskia zinniaeflora.

16. Pereskia horrida (HBK.) De Candolle, Prodr. 3: 475. 1828.

Cactus horridus Humboldt, Bonpland, and Kunth, Nov. Gen. et Sp. 6: 70. 1823.

Tree, 4 to 6 meters high, with terete slender branches; spines often solitary, sometimes 2 or 3, slender, dark in color, unequal, the longest 2 to 3 cm. long; leaves solitary, alternate, narrowly oblong, 3 cm. long, subsessile, entire, glabrous; flowers 3 to 5 together in upper axils, about 10 mm. long; calyx described as 5-toothed and persistent; petals 5 or 6, red, lanceolate, spreading; fruit fleshy, many-seeded.

Type locality: "Ad flumen Marañon prov. Jaen de Bracamoros." (Schumann says this locality is in Peru.)

Distribution: Northwestern South America.

The above description is compiled from Kunth's original description and from notes made by Dr. Rose upon the type material in the herbarium of the Museum of Natural History at Paris, in which there are specimens from both Bonpland and Kunth. Both of these sheets lack flowers and fruit, and only Kunth's bears leaves. So far as we are aware,

no other material of this species has been collected since Humboldt's time except that in 1912 Dr. Weberbauer wrote that he had visited the Marañon, at Humboldt's locality, and had collected a single specimen, which had been sent to the Botanical Museum at Berlin.

17. **Pereskia cubensis** Britton and Rose, Torreya 12: 13. 1912.

A tree, 4 meters high, with a trunk 2.5 dm. in diameter and a large, flat, much branched top; bark brownish, rather smooth, marked here and there by black bands (representing the old areoles), these broader than high; young branches slender, smooth, with light-brown bark; spines from young areoles 2 or 3, needle-like, brownish, 2 to 4 cm. long, from old areoles very numerous (25 or more), and much longer (5 cm. or more long); leaves several at each areole, sessile, bright green on both sides, oblanceolate to oblong or obovate, 1 to 4 cm. long, 10 to 12 mm. wide, acute at both ends or obtuse at the apex, fleshy, the midvein broad, the lateral veins very obscure; peduncle very short, jointed near the base, bearing 1 to 3 leaf-like bracts; flowers terminal and also axillary, solitary; sepals 5, obtuse or rounded, ovate-oblong to orbicular, unequal, 7 to 9 mm. long, the larger ones with broad purple margins; petals 8, about 15 mm. long, deep reddish purple, obovate-elliptic, rounded; stamens many, about 6 mm. long; anthers light yellow; ovary turbinate, naked, spineless; fruit not seen.

Fig. 18.—Pereskia cubensis.

Fig. 19.—Pereskia cubensis. ×0.5

Type locality: In Cuba.

Distribution: Near the southern coast of eastern and central Cuba.

The tree is abundant on the plain between Guantánamo and Caimanera, Oriente, where the type specimens were collected; it also inhabits coastal thickets at Ensenada de Mora, in southwestern Oriente, the plants of this colony bearing leaves with less acute apices than those of the typical ones. A single plant was also observed on La Vigia Hill, at Trinidad, province of Santa Clara, which had shorter and smaller leaves than either of the other two. The description of the flower is from one of a plant collected by N. L. Britton and J. F. Cowell at Ensenada de Mora, southern Oriente, Cuba, in 1912, and brought to the New York Botanical Garden, where it flowered in May 1917.

Dr. Rose finds that the plant in De Candolle's herbarium which represents the *Pereskia portulacifolia* of the Prodromus is undoubtedly *Pereskia cubensis*. It was collected as early as 1821.

Illustration: Journ. N. Y. Bot. Gard. 10: f. 22.

Figure 18 is from a photograph taken by Dr. M. A. Howe in the colony of this tree at Nuevaliches, near Guantánamo, Cuba, studied by Dr. N. L. Britton in 1909; figure 19 represents a leafy branch of the same plant.

18. Pereskia portulacifolia (Linnaeus) Haworth in De Candolle, Prodr. 3: 475. 1828.

Cactus portulacifolius Linnaeus, Sp. Pl. 469. 1753.

A tree, 5 to 6.6 meters high, the branches terete, very spiny; spines acicular, sometimes almost bristle-like, 2 cm. long, on old wood in clusters of 7 to 9, but on new growth usually solitary; leaves

FIG. 20.—Pereskia portulacifolia. ×0.66.

only 1 cm. long or less, cuneate at base, often retuse at apex; peduncles short but definite, 2 to 5 mm. long, bearing several small spatulate to broadly obovate leaves; flowers rose-colored, about 3 cm. broad; sepals about 3, ovate to shortly oblong, obtuse, fleshy, 8 mm. or less long; petals oblong, about 2 cm. long, thin, obtuse; ovary small, truncate, naked or bearing a single small leaf; immature fruit hard, depressed, 2 cm. long, 2.5 cm. broad, smooth, naked or with a single small leaf 5 to 6 mm. long, with a broad scar at the top 8 to 10 mm. in diameter; fruit globular, naked; seeds large, black.

Type locality: Tropical America, doubtless Hispaniola.

Distribution: Haiti.

The usual reference for the first publication of the plant under *Pereskia* is Haworth's Synopsis (Syn. Pl. Succ. 199. 1812), but it was not here formally transferred from the genus *Cactus*. His statement is: "*Cactus portulacifolius* is another species of this genus."

Our knowledge of this plant is drawn from the illustration below cited and descriptions, and from a fragmentary specimen collected by W. Buch near Gonaives, Haiti, in 1900,

where it grows on dry calcareous rocks, and one obtained by Paul Bartsch at Tomasean in April 1917. Dr. Bartsch states that the flower reminds one very much of a rose and the fruit is pendent like a green plum.

Lunan in 1814 (Hort. Jam. 2: 236) described a tree nearly a foot in diameter, growing at a residence near Spanish Town, Jamaica, stating that it differed from *Pereskia* by the absence of tufts of leaves on its fruit. His description points to *Pereskia portulacifolia*, but nothing is known of the species in Jamaica at the present day; according to Grisebach, Macfadyen recorded it as cultivated there.

Illustration: Plumier, Pl. Amer. ed. Burmann pl. 197, f. 1.

Figure 20 is copied from the illustration above cited.

19. Pereskia conzattii sp. nov.

Tree, 8 to 10 meters high; bark of stems and branches brown and smooth; leaves orbicular to obovate, acute, 1 to 2.5 cm. long; areoles small, with short white wool and a few long hairs; spines 2 to 6 on young branches, 10 to 20 on main stem, acicular, 2 to 2.5 cm. long, at first yellowish brown, dark brown in age; flowers not known; ovary bearing small scales; fruit naked, pear-shaped, more or less stalked at base, 3 to 4 cm. long; seeds black, glossy, 3 mm. long, with a small white hilum.

Collected at Salina Cruz and Tehuantepec, Oaxaca, Mexico, in February and April, 1913, by Professor C. Conzatti; probably also in Guatemala.

Species Unknown to Us.

Pereskia affinis and *P. haageana* Meinshausen, Wochenschr. Gärtn. Pflanz. 2: 118. 1859.

Pereskia cruenta, *P. grandiflora*, and *P.(?) plantaginea*, the first two given as synonyms and the last merely mentioned by Pfeiffer (Enum. Cact. pp. 176, 177, and 179) can not be identified. The same is true of *P. grandispina* Forbes (Journ. Hort. Tour Germ. 159. 1837).

Tribe 2. OPUNTIEAE.

Plants usually very fleshy, never epiphytic, branched (usually much branched), one to many-jointed; joints diverse in structure, terete, compressed, or much flattened, with irregularly scattered areoles, ribless, except one species; leaves usually caducous, but in some species more or less persistent, small or minute, subulate or cylindric, in one genus broad and flat; areoles usually glochidiferous (except in *Maihuenia;* in *Grusonia* only those of the ovary), mostly spine-bearing; spines usually slender, straight or nearly so, sometimes sheathed; corolla mostly rotate (sepals and petals in *Nopalea* erect); flowers sessile, diurnal, one from an areole; fruit usually a fleshy berry, sometimes dry, rarely capsular; seed white or black, globular, flattened or even winged, with a thin or hard testa; cotyledons large, elongated.

This tribe contains 7 genera and at least 300 species, various in habit, flower, fruit, and seeds. It is more closely related to the *Pereskieae* than to the *Cereeae*. The following characters possessed by some or all genera of the *Opuntieae* are wanting in the *Cereeae:*

Leaves on the stem (see also *Harrisia* and *Hylocereus*); glochids in the areoles; sensitive stamens; sheathed spines; winged, white, and bony-covered seeds; the separation of withering calyx, stamens, and style from the ovary; areoles irregularly distributed over the stem in all the genera except *Grusonia*, in which they are arranged on ribs as in many of the *Cereeae*.

The tribe is distributed throughout the cactus regions of the Americas, but the genera, except *Opuntia*, are localized.

Key to Genera.

Leaves broad and flat ..... 1. *Pereskiopsis*
Leaves subulate or cylindric.
  Seeds broadly winged ..... 2. *Pterocactus*
  Seeds wingless.
    Stamens much longer than the petals.
      Petals erect; joints flat ..... 3. *Nopalea*
      Petals recurved; joints terete ..... 4. *Tacinga*
    Stamens shorter than the petals.
      Joints flat to terete, not ribbed.
        Testa of the seed thin, black, shining ..... 5. *Maihuenia*
        Testa thick, pale, dull ..... 6. *Opuntia*
      Joints terete, longitudinally ribbed ..... 7. *Grusonia*

1. **PERESKIOPSIS** Britton and Rose, Smiths. Misc. Coll. **50**: 331. 1907.

Trees and shrubs, in habit and foliage similar to *Pereskia;* old trunk forming a solid woody cylinder covered with bark and resembling the ordinary dicotyledonous stem; areoles circular, spine-bearing or sometimes spineless, also bearing hairs, wool, and usually glochids; flowers similar to those of *Opuntia;* ovary sessile (one species described as pedunculate), with leaves at the areoles (except in one species); fruit red, juicy; seeds bony, few, covered with matted hairs.

Type species: *Opuntia brandegeei* Schumann.

The plants are common in hedges and thickets of Mexico and Guatemala.

As to the number of species to be recognized in this genus we are uncertain; about 16 have been described. In our first discussion of the genus (*op. cit.*) we recognized 11 species, including several known only from descriptions. There now seem to be at least 10 species, of which 8 are in cultivation in Washington and New York. Two of the plants were described, as early as 1828, as species of *Pereskia*, and here they remained with 2 later-described species until, in 1898, Dr. A. Weber transferred them to *Opuntia*, placing them in a new subgenus, *Pereskiopuntia*. The same year Dr. Karl Schumann adopted Weber's conclusions, publishing his treatment of the subgenus and assigning 5 species to it.

In its large leaves and woody, spiny stems, this group suggests *Pereskia*, but it has glochids and different flowers, fruit, and seeds; in flowers, fruit, seeds, and glochids it resembles *Opuntia*, but on account of habit and foliage must be excluded from that genus.

In view of these differences, Britton and Rose in 1907 established the genus *Pereskiopsis* and listed 11 species, 4 of which had been originally described as species of *Pereskia* and 5 as species of *Opuntia*. Since then we have grown most of these plants along with the pereskias and opuntias so as to compare them. Unfortunately we are not able to describe all the species fully, for they have never been known to flower in cultivation, although some of the species, at least, bloom freely in the wild state. The leaves on the lower parts of shoots are sometimes broader and shorter than those on the upper parts, and in greenhouse cultivation the leaves of some species are narrower than when the plants are growing under natural conditions.

The generic name is from the Greek and signifies resembling *Pereskia*.

Key to Species.

Stems, ovary, and often the leaves more or less pubescent.
- Normal leaves long-acuminate, narrow, with narrow cuneate bases ..... 1. *P. velutina*
- Normal leaves abruptly pointed, somewhat cuneate at base ..... 2. *P. diguetii*

Stems, ovary, and leaves glabrous.
- Leaves, at least some of them, not much longer than broad.
  - Fruit without leaves, at least so figured ..... 3. *P. opuntiaeflora*
  - Fruit with leaves subtending the areoles.
    - Areoles white, with few glochids or none.
      - Leaves orbicular or nearly so, rounded or apiculate ..... 4. *P. rotundifolia*
      - Leaves, at least the upper ones, obovate or elliptic, acute at both ends ..... 5. *P. chapistle*
    - Areoles dark, filled with numerous brown glochids ..... 6. *P. porteri*
- Leaves, at least some of them, twice as long as broad or longer.
  - Leaves spatulate ..... 7. *P. spathulata*
  - Leaves elliptic to oblong, or obovate.
    - Leaves pale green, glaucous ..... 8. *P. pititache*
    - Leaves bright green, shining.
      - Glochids few, yellow ..... 9. *P. aquosa*
      - Glochids many, brown ..... 10. *P. kellermanii*

1. **Pereskiopsis velutina** Rose, Smiths. Misc. Coll. **50**: 333. 1907.

Stems weak and spreading, forming compact bushes 9 to 12 dm. high or sometimes higher; old stems with cherry-brown bark; young branches green, borne nearly at right angles to the old stem, velvety-pubescent; areoles bearing long white hairs and several short spines and some glochids; leaves elliptic to ovate-elliptic, 2 to 6 cm. long by 1.5 to 2.5 cm. broad, acuminate, or acute at both ends, dull green, more or less velvety-puberulent on both surfaces, when very young brighter green; flowers sessile on the second-year branches; ovary obovoid to oblong, pubescent, bearing large

leaves and areoles similar to those of the stem; leaves on ovary spreading or ascending and persisting after the flower falls; flower-bud (above the ovary) 2 to 3 cm. long, acute; sepals green or deep red tinged with yellow; petals bright yellow.

Type locality: In hedges about city of Querétaro, Mexico.

Distribution: Table-lands of central Mexico.

This plant is called by the natives nopaleta and cola de diablo.

Illustration: Smiths. Misc. Coll. 50: pl. 44.

Figure 21 is from a photograph of type plant.

FIG. 21.—Pereskiopsis velutina.

2. **Pereskiopsis diguetii** (Weber) Britton and Rose, Smiths. Misc. Coll. 50: 332. 1907.

Opuntia diguetii Weber, Bull. Mus. Hist. Nat. Paris 4: 166. 1898.

Tall shrub, larger than the preceding species; old stems reddish; branches pubescent; areoles when young filled with long, white, cobwebby hairs, when old large and filled with short black wool; leaves elliptic to obovate, 3 to 5 cm. long, usually abruptly pointed, more or less cuneate at the base; spines usually 1, rarely as many as 4, at first nearly black, in time becoming lighter, sometimes nearly 7 cm. long; glochids brownish, not very abundant; flowers yellow; fruit 3 cm. long, red, pubescent, its areoles often bearing spines as well as glochids; seeds white, 5 mm. broad, covered with matted hairs.

Type locality: Near Guadalajara, Mexico.

Distribution: Central Mexico.

Common in hedges near Guadalajara and Oaxaca, Mexico. According to W. E. Safford, it is known in Guadalajara as tasajillo and alfilerillo.

Figure 22 represents a leafy branch of a plant collected by W. E. Safford in Guadalajara, Mexico, in 1907.

3. **Pereskiopsis opuntiaeflora** (De Candolle) Britton and Rose, Smiths. Misc. Coll. 50: 332. 1907.

Pereskia opuntiaeflora De Candolle, Prodr. 3: 475. 1828.
Opuntia golziana Schumann, Gesamtb. Kakteen 654. 1898.

Shrubby, glabrous; leaves obovate, mucronate, often in pairs; spines, when present, solitary, elongated, 2 to 3 times as long as the leaves; flowers subterminal, short-pedunculate; petals numerous, ovate, subacute, reddish yellow, arranged in two series; ovary leafless, bearing areoles filled with glochids.

Type locality: In Mexico.

Distribution: Known only from the original description.

This description is drawn from De Candolle's original description and illustration; otherwise nothing is known of the plant.

This species, as illustrated by De Candolle, is unlike anything we know. In its pedunculate fruit it is like *Pereskia*, but its leafless ovary and its areoles filled with glochids would exclude it from that genus. In a general way the illustration looks more like a *Pereskiopsis*, and we suspect that the delineation is incorrect or that the leaves had fallen away from the specimen drawn.

Cactus opuntiaeflorus Mociño and Sessé (Pfeiffer, Enum. Cact. 178. 1837) was published as a synonym of *Pereskia opuntiaeflora*.

Illustrations: Förster, Handb. Cact. ed. 2. f. 137; Mém. Mus. Hist. Nat. Paris **17**: pl. 19, both as *Pereskia opuntiaeflora*.

Figure 23 is copied from the second illustration above cited.

4. **Pereskiopsis rotundifolia** (De Candolle) Britton and Rose, Smiths. Misc. Coll. **50**: 333. 1907.

Pereskia rotundifolia De Candolle, Prodr. 3: 475. 1828.
Opuntia rotundifolia Schumann, Gesamtb. Kakteen 652. 1898.

Stem thick, more or less woody; branches slender, glabrous; leaves nearly orbicular, mucronate; spines elongated, solitary; flowers 3 cm. broad, borne on the second-year branches; petals reddish yellow. broad, with mucronate tips; ovary leafy; fruit obovoid, red, leafy.

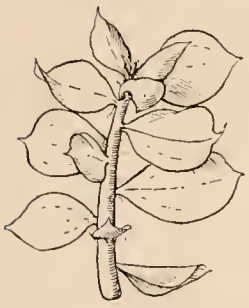


FIG. 22.—Pereskiopsis diguetii. ×0.5.

FIG. 23.—Pereskiopsis opuntiaeflora. ×0.5.

FIG. 24.—Pereskiopsis rotundifolia. ×0.5.

Type locality: In Mexico.

Distribution: Known only from the original description and, apparently, from Oaxaca.

Cactus frutescens Mociño and Sessé (Pfeiffer, Enum. Cact. 178. 1837) and *Cactus rotundifolia* Mociño and Sessé (De Candolle, Prodr. 3: 475. 1828) were given as synonyms of *Pereskia rotundifolia*, but were never published.

Illustrations: Mém. Mus. Hist. Nat. Paris **17**: pl. 20, as *Pereskia rotundifolia;* Schumann, Gesamtb. Kakteen f. 99, as *Opuntia rotundifolia*.

Figure 24 is copied from the first illustration above cited; figure 25 is from a photograph taken by Dr. MacDougal at Oaxaca, Mexico, in 1906.

5. **Pereskiopsis chapistle** (Weber) Britton and Rose, Smiths. Misc. Coll. **50**: 331. 1907.

Opuntia chapistle Weber in Gosselin, Bull. Mus. Hist. Nat. Paris **10**: 388. 1904.

A large, branching shrub, sometimes 3 to 4 meters high, the branches widely spreading, glabrous; spines single, white, long (6 cm. long), very stout; leaves fleshy, somewhat persistent, obovate to elliptic, sometimes nearly orbicular, 3 to 4 cm. long, glabrous; flowers yellow; fruit red.

Type locality: In Oaxaca.

Distribution: Oaxaca and perhaps Morelos, Mexico.

Illustration: Bull. Soc. Nat. Acclim. France **52**: f. 10, as *Opuntia chapistle*.

Plate III, figure 2, represents a leafy branch of a plant collected by Dr. Rose at Cuernavaca, Mexico, in 1906.

FIG. 25.—Pereskiopsis, apparently P. rotundifolia, with other cacti in the background.

6. **Pereskiopsis porteri** (Brandegee) Britton and Rose, Smiths. Misc. Coll. **50**: 332. 1907.

Opuntia porteri Brandegee in Weber, Dict. Hort. Bois 899. 1898.
Opuntia brandegeei Schumann, Gesamtb. Kakteen 653. 1898.
Pereskiopsis brandegeei Britton and Rose, Smiths. Misc. Coll. **50**: 331. 1907.

Stems stout, woody, branching, 6 to 12 dm. high, 3 cm. in diameter, the old areoles bearing 3 to 8 stout spines 3 to 5 cm. long, but on the trunk often 15 to 20 spines from an areole; first and second year branches usually short, spineless, or with 1 or 2 brown spines, those of the first year green, the second-year brownish; areoles bearing numerous small, brown glochids; leaves sessile, 2 to 3 cm. long, obovate, acute, fleshy, in greenhouse specimens sometimes much narrower; flowers about 4 cm. in diameter; sepals few, spatulate, short; petals few, yellow, broad, entire; fruit joint-like, oblong, 4 to 5 cm. long, orange-colored, with large areoles bearing brown glochids; seeds 1 or few, covered with white deciduous hairs.

Type locality: In Sinaloa, Mexico.

Distribution: Common in the Cape region of Lower California and in the State of Sinaloa, Mexico.

Figure 26 shows a leafy twig of a plant sent in 1904 from the Missouri Botanical Garden to the New York Botanical Garden as *Opuntia brandegeei*, which had been received by the Missouri Botanical Garden from Mrs. Katharine Brandegee in 1901.

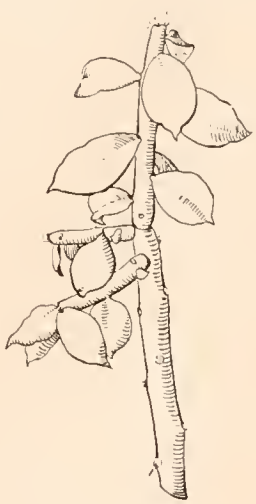


FIG. 26.—Pereskiopsis porteri. ×0.66

7. **Pereskiopsis spathulata** (Otto) Britton and Rose, Smiths. Misc. Coll. **50**: 333. 1907.

Pereskia spathulata Otto in Pfeiffer, Enum. Cact. 176. 1837.
Opuntia spathulata Weber, Bull. Mus. Hist. Nat. Paris **4**: 165. 1898.

Branching shrub, 1 to 2 meters high; branches few, glaucescent, deflexed; leaves spatulate, thick, green, 2.5 to 5 cm. long; areoles distant, woolly, hairy when young; spines 1 or 2, rigid, white below, 2.5 cm. long; glochids brown, borne in the upper part of the areoles; flowers red; seeds white.

Type locality: In Mexico.

Distribution: Probably southern Mexico, but no definite locality is known.

There is some confusion in the literature of this species; Schumann describes it as pubescent, while in the original description nothing is said about pubescence; this error is probably due to a misidentification, for Dr. Rose found in the Museum of Paris two specimens collected by Diguet at Guadalajara, Mexico, which were labeled *Opuntia spathulata*, and which have pubescent branches and leaves; these are undoubtedly *O. diguetii*.

Pereskia crassicaulis Zuccarini (Pfeiffer, Enum. Cact. 176. 1837) was never published, simply being given as a synonym of *P. spathulata*.

8. Pereskiopsis pititache (Karwinsky) Britton and Rose, Smiths. Misc. Coll. **50**: 332. 1907.

Pereskia pititache Karwinsky in Pfeiffer, Enum. Cact. 176. 1837.
Pereskia calandriniaefolia Link and Otto in Salm-Dyck, Cact. Hort. Dyck. 1849. 252. 1850. (According to Schumann.)
Opuntia pititache Weber, Bull. Mus. Hist. Nat. Paris **4**: 165. 1898.

Stems rather low and somewhat branching; bark light brownish and flaking off; areoles on main trunk each bearing 1 to 4 slender acicular spines and a small cluster of yellowish glochids; branches, even when several years old, bearing a single long, acicular spine from an areole and no glochids; young and growing branches rather slender and green, their areoles small, black in the center, with long, white hairs from their margins and no spines; leaves obovate or oblong-obovate, 4 cm. long or less, pale green, thin, acute or bluntish at the apex, narrowed at the base.

Type locality: In Mexico.

Distribution: Uncertain, but reported from southern Mexico.

In the original description this species is said to have a very spiny, erect woody trunk, the branches spreading nearly horizontally, the spines unequal, 3 to 6, 25 to 37 mm. long, the leaves fleshy, green, lanceolate to ovate, 37 mm. long, 16 mm. broad. It was named by Baron Wilhelm von Karwinsky and probably collected by him in Mexico, but no definite locality was given; Weber states it is from Tehuantepec, while Schumann gives Tehuacán on a statement of Weber.

Pereskia calandriniaefolia we have referred here, following Schumann, but the original description is somewhat different from that of *P. pititache*, the leaves being described as spatulate to lanceolate, strongly narrowed below, 7.5 cm. long.

Our description is mostly drawn from specimens growing in the New York Botanical Garden obtained from M. Simon, of St. Ouen, Paris, in 1901.

Illustrations: Abh. Bayer. Akad. Wiss. München **2**: pl. 1, sec. 6, f. 1, 2; pl. 2, f. 9, both as *Pereskia pititache*.

Plate III, figure 3, represents a leafy shoot of a plant sent by M. Simon, of St. Ouen, Paris, France, to the New York Botanical Garden in 1901.

9. Pereskiopsis aquosa (Weber) Britton and Rose, Smiths. Misc. Coll. **50**: 331. 1907.

Opuntia aquosa Weber, Bull. Mus. Hist. Nat. Paris **4**: 165. 1898

Shrub, with glabrous, glaucous, green branches, the young shoots with long white hairs at the areoles; leaves bright green, nearly elliptic, acute, about twice as long as wide, narrowed at the base, glabrous; spines usually solitary, standing at right angles to the stem, white; glochids few, yellow; flowers yellow; outer petals blotched with red; fruit pear-shaped, 4 to 5 cm. ong, 2 to 2.5 cm. in diameter, yellowish green.

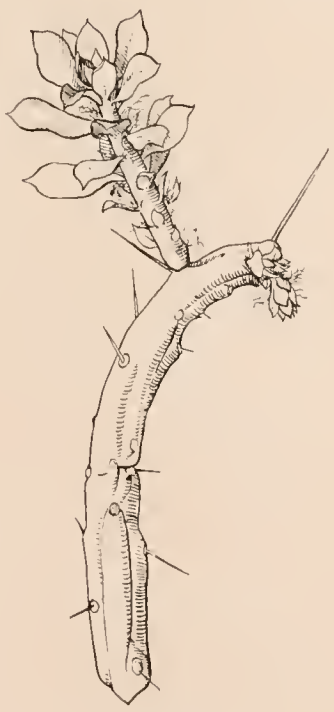


FIG. 27.—Pereskiopsis aquosa. ×0.66.

Type locality: Guadalajara, Mexico.

Distribution: In hedges about Guadalajara, Mexico.

The fruit, called in Mexico tuna de agua and tasajillo, is used in making a cooling drink and for preserves.

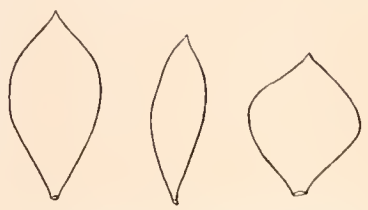
Opuntia spathulata aquosa (Bull. Mus. Hist. Nat. Paris 4: 165. 1898) was given as a synonym of this species, but was never published.

Illustration: Safford, Ann. Rep. Smiths. Inst. 1908: pl. 10, f. 2.

Figure 27 represents a leafy shoot of the plant collected by W. E. Safford near Guadalajara, Mexico, in 1907.

10. Pereskiopsis kellermanii Rose, Smiths. Misc. Coll. 50: 332. 1907.

Stem glabrous, herbaceous, weak, and clambering over shrubs to a length of 4 to 5 meters, about 2 cm. in diameter; second-year branches usually at right angles to main stem, with cherry-red bark; old stem bearing several slender, acicular brown spines, sometimes only 1, sometimes wanting, and numerous brown glochids; young branches green, fleshy, their areoles circular, white, filled with long white hairs, brown glochids, and often with several acicular brown spines; spines on wild plants often stout, usually solitary, nearly black, 2 to 3 cm. long; leaves various, shining green, glabrous, thickish, elliptic and two or three times as long as wide, or suborbicular, acute at the apex, narrowed at the base, 5 cm. long or less, 2 to 2.5 cm. broad; flowers not known; fruit red, glabrous, leafy, 3 to 6 cm. long, bearing large areoles filled with brown glochids; seeds covered with matted hairs.



FIGS 28, 29, and 30.—Pereskiopsis kellermanii, showing three leaf forms. ×0.5.

Type locality: Trapichite, Guatemala.

Distribution: Guatemala.

Figures 28, 29, and 30 are copied from sketches of the leaf-forms of the type plant, made by W. A. Kellerman in Guatemala in 1908.

2. PTEROCACTUS Schumann, Monatsschr. Kakteenk. 7: 6. 1897.

Stems low, more or less branched above, cylindric, from tuber-like and often greatly enlarged roots; leaves minute, caducous; spines weak, several or many at each areole; glochids small, caducous as in *Opuntia;* flower terminal, regular, without tube; perianth-segments several, erect; filaments and pistil shorter than the petals; ovary nearly turgid, bearing numerous small clusters of spines; fruit dry, capsular, dehiscent; seeds winged, white; embryo curved.

Type species: *Pterocactus kuntzei* Schumann.

Four species have already been described, but three of these we have combined and the fourth is referred to *Opuntia.* Three additional species, however, are here described. The generic name refers to the winged seeds.

This is a remarkable genus, and it is surprising that it remained unrecognized so long, for one of its species was known as long ago as 1837; the fruit and seeds, however, seem not to have been known until about 1897. In habit the plants are nearest some of the anomalous species of *Opuntia,* having large roots and short, weak stems like *Opuntia chaffeyi,* of Mexico; the seeds, however, differ, not only from those of *Opuntia,* but from those of all other cactus genera, in being winged. The fruit, according to Schumann, although we have not been able to confirm his observation definitely, is a capsule with an operculum. Another peculiarity is that the fruit is borne in the end of the stem or branch.

While this genus has good characters, it is no more distinct than many others and does not deserve the relative importance given to it by T. von Post and Otto Kuntze in Lexicon Generum Phanerogamarum, who treat it as one of the only three cactus genera to be conserved, in their view.

KEY TO SPECIES.

Seeds narrowly winged; spines up to 2 cm. long ..... 1. *P. hickenii*
Seeds broadly winged; spines 3 to 10 mm. long.
  Joints strongly tuberculate ..... 2. *P. fischeri*
  Joints scarcely tuberculate.
    Ovary densely covered with weak spines; wing of seed 1 mm. wide ..... 3. *P. pumilus*
    Ovary loosely covered with stiff spines; wing of seed 2 mm. wide ..... 4. *P. tuberosus*

FIGS. 31, 32.—Pterocactus hickenii. ×0.7.

FIG. 33.—Pterocactus fischeri. ×1.12. Photograph by Paul G. Russell.

1. Pterocactus hickenii sp. nov.

Rootstocks moniliform, consisting of at least 4 joints widely separated; joints above ground 2 or 3, 2 to 3 cm. long, almost hidden by the spines; spines from each areole numerous, slender, yellow above, brown at base; glochids numerous; fruit and flower not known; seeds thick, 5 mm. in diameter, with narrow lateral wing.

Collected by Cristóbal M. Hicken (No. 3284) January 10, 1914, near Comodoro Rivadavia, southeastern Chubut, Argentina.

Figures 31 and 32 represent a plant and a seed from the specimen above cited

FIGS. 34, 35, 36.—Seeds of three species of Pterocactus. Natural size.

2. Pterocactus fischeri sp. nov.

Stems low, 1 dm. high or less, spreading or erect, cylindric, 1.5 cm. in diameter, tuberculate; leaves minute, acute; tubercles about as long as broad, arranged in spiral ridges somewhat resembling those of *Opuntia whipplei;* spines numerous, the radials 12 or more, white, setaceous, 6 mm. long, spreading; centrals usually 4, 1 to 1.5 cm. long, brownish, the tips and bases often yellowish;

glochids numerous, yellowish, 3 to 4 mm. long; flowers, in only specimen seen, terminal, almost continuous with the stem; ovary tuberculate and spiny like the stem, deeply umbilicate; seed one, large, flat-winged.

Collected by Walter Fischer in 1914 in the Province of Río Negro, Argentina, and given to Dr. Rose during his visit to Argentina in 1915 by Professor Cristóbal M. Hicken.

While this species resembles some of the species of *Cylindropuntia* of the United States, the spines are not sheathed.

Figure 33 is from a photograph of the specimen above cited; figure 34 shows a seed of the same specimen.

3. Pterocactus pumilus sp. nov.

Plants low, usually prostrate or ascending; joints cylindric, 1 cm. in diameter, covered with weak appressed spines; areoles very woolly; flower terminal; ovary sunk in the apex of the terminal joint, somewhat umbilicate; ovules several; seed flattened, 7 mm. in diameter, very thin.

Collected by Cristóbal M. Hicken (No. 3286), January 8, 1914, at Puerto Piramides, Chubut, Argentina.

Figure 35 shows a seed of above specimen.

4. Pterocactus tuberosus (Pfeiffer).

Opuntia tuberosa Pfeiffer, Enum. Cact. 146. 1837.
Pterocactus kuntzei Schumann, Monatsschr. Kakteenk. 7: 6. 1897.
Pterocactus kurtzei Schumann in Engler and Prant', Pflanzenfam. Nachtr. 259. 1897.
Pterocactus decipiens Gürke, Monatsschr. Kakteenk. 17: 147. 1907.

Roots tuber-like, single or in clusters, usually small but sometimes large and thick, up to 12 cm. long by 8 cm. in diameter, deep-seated, giving off several erect stems, these branching at surface of the ground; terminal branches purplish, turgid, 3 to 40 cm. long, 1 cm. in diameter, more or less clavate; areoles numerous, small, bearing numerous small white appressed spines; flowers terminal, 2 to 3 cm. long; petals long, lanceolate, apiculate, yellow; ovary with numerous areoles bearing long bristles; ovules numerous; fruit dry; seeds large, flat, winged, 10 to 12 mm. in diameter.

Type locality: Near Mendoza, Argentina.

Distribution: Western provinces of Argentina, chiefly in the mountains.

FIG. 37.—Pterocactus tuberosus. Natural size. Photograph by Paul G. Russell.

We have not seen the type of *P. kuntzei*, which is doubtless at Berlin, but we have examined cotypes in the Kurtz Herbarium at Córdoba, Argentina, and at New York.

Opuntia tuberosa, described from Mendoza as long ago as 1837, has long been a puzzle to botanists, who have tried to associate it with various opuntias. Dr. Rose, who visited Mendoza in 1915, found a tuberous-rooted cactus in the mountains above that city, which we are convinced is the plant described by Pfeiffer. There is no doubt, on the other

hand, that it is *Pterocactus kuntzei*, from the same region, which was described as new by Schumann in 1897.

Opuntia alpina Gillies (Pfeiffer, Enum. Cact. 146. 1837) was not published, but was given as a synonym of *Opuntia tuberosa*. Schumann referred both names to *Opuntia platyacantha*.

Illustrations: Monatsschr. Kakteenk. 7: 7; Schumann, Gesamtb. Kakteen f. 107, both as *Pterocactus kuntzei;* Blühende Kakteen 3: pl. 140, as *P. decipiens*.

Figure 36 shows a seed of a plant, collected by Dr. Rose near Mendoza, Argentina, in 1915; figure 37 is from a photograph of same plant; figure 38 is from a photograph taken by Dr. Carlos Spegazzini.

FIG. 38.—Pterocactus tuberosus.

3. **NOPALEA** Salm-Dyck, Cact. Hort. Dyck. 1849. 63. 1850.

Much branched cacti with definite cylindric trunks; roots so far as known fibrous; branches or joints flattened, fleshy, often narrow; glochids usually less abundant than in *Opuntia;* spines solitary or in clusters at the areoles, sheathless; leaves small, subterete, soon deciduous; areoles bearing white wool, glochids, and often spines; flowers originating in the areoles usually at or near the edges of the joints; sepals ovate, erect; petals red or pinkish, erect, closely appressed against the numerous stamens and the style; filaments and style slender, much longer than the petals; ovary more or less tuberculate, naked or spiny, with a very deep umbilicus; fruit a juicy berry, red, edible, usually spineless; seeds numerous, flat, covered by a hard bony aril.

Nopalea is closely related to *Opuntia*, with which it is sometimes united; the erect petals and elongated filaments and style are constant in *Nopalea*, however.

Three species were included by Salm-Dyck in this genus when it was described, of which *Opuntia cochenillifera* Linnaeus was the first and is therefore considered the type.

Karl Schumann described five species in his monograph, but since then two species, *N. guatemalensis* and *N. lutea*, have been described by Dr. Rose, and one, *N. inaperta*, by Dr. Griffiths. *N. moniliformis* (Linnaeus) Schumann, based on plate 198 of Plumier, is *Opuntia moniliformis* (Linnaeus) Steudel.

The species are natives of Mexico and Guatemala, and have been accredited to Cuba, although none has recently been observed wild on that island. Some of them are widely

cultivated and may be found throughout the warmer parts of the world. Two are of some economic importance and two or three are grown as ornamentals.

The name *Nopalea* is doubtless from nopal, the common name of Mexicans for certain opuntias and nopaleas.

Key to Species.

Spineless, or rarely a few short spines on old joints	1.	*N. cochenillifera*
Joints spiny (spines few in *N. auberi*).		
Spines, at least those of young joints, very slender, acicular, several at each areole.		
Spines white	2.	*N. guatemalensis*
Spines yellow or becoming brown.		
Joints obovate to oblong, 10 to 22 cm. long, 5 to 10 cm. wide	3	*N. lutea*
Joints linear-oblong to oblong-lanceolate, 6 to 12 cm. long, 2 to 3 cm. wide	3a.	*N. gaumeri*
Spines stouter, subulate.		
Areoles with 1 or 2 spines, or spineless; joints glaucous	4	*N. auberi*
Areoles with 2 to 4 spines; joints green.		
Joints linear or linear-oblong, 4 to 7 times as long as wide	5.	*N. dejecta*
Joints oblong or oblong-obovate, 2 to 4 times as long as wide.		
Spines 2 to 4; joints not tuberculate	6.	*N. karwinskiana*
Spines 4 to 12; joints strongly tuberculate	7.	*N. inaperta*

1. Nopalea cochenillifera (Linnaeus) Salm-Dyck, Cact. Hort. Dyck. 1849. 64. 1850.

Cactus cochenillifer Linnaeus, Sp. Pl. 468. 1753.
Opun'ia cochinelifera Miller, Gard. Dict. ed. 8. No. 6. 1768.

Often tall plants, 3 to 4 meters high, with trunks up to 2 dm. thick; branches of ascending or spreading oblong joints, sometimes 5 dm. long, green, bright green at first; spines none or rarely minute ones develop on the older joints; glochids numerous, caducous; leaves small, awl-shaped, soon deciduous; flowers appearing from the tops of the joints, usually in great abundance; flower, from base of ovary to tip of style, 5.5 cm. long; ovary nearly globular, 2 cm. long, with low diamond-shaped tubercles, its areoles bearing many glochids; sepals broadly ovate, acute, scarlet; petals a little longer than the sepals, otherwise similar, persistent; stamens pinkish, exserted 1 to 1.5 cm. beyond the petals; stigma-lobes 6 or 7, greenish, exserted beyond the stamens; style swollen just above its base into a broad disk; fruit red, about 5 cm. long, rarely maturing in greenhouse plants; seeds about 5 mm. long and 3 mm. wide.

Type locality: Jamaica and tropical America.

Distribution: Cultivated in the West Indies and tropical America; its original habitat unknown.

Opuntia magnifolia Noronha (Verhandl, Batav. Genootsch. 5^4: 22. 1790), published without description, is referred to this species by Schumann and others. The name *Opuntia mexicana*, although it has been used for more than one species, first appeared in Pfeiffer's Enumeratio (p. 150. 1837) as a synonym of *O. cochenillifera*. *Cactus subinermis* Link (Steudel, Nom. ed. 2. 1: 246. 1840) is given as a synonym of *Opuntia cochenillifera*.

The specific name of this plant was given because it is one of the species of cactus from which cochineal was obtained. Cochineal was long supposed to be a vegetable product; it was not until 1703 that, by the aid of the microscope, it was definitely determined to be of insect origin. The cochineal industry is of prehistoric origin. The Spaniards found it well established when they conquered Mexico in 1518, and began at once to export the product. As early as 1523 Cortez was ordered to obtain and send to Spain as much as he possibly could, while during the early colonial days it was one of the chief articles of tribute to the crown. From Mexico and Peru the industry was taken to southern Spain, India, Algiers, South Africa, New Granada (Colombia), Jamaica, and the Canary Islands. The industry grew rapidly and was very profitable. The greatest source of the cochineal was probably the Canary Islands. In about the year 1868 more than 6,000,000 pounds, valued at $4,000,000, were exported from these islands alone, of which the largest part was sent to England.

The cochineal insects were placed on the joints or branches of the cactus plants, where they rapidly multiplied and in about four months were collected by brushing them off into baskets or bags. Then, after being dried in various ways, they became the cochineal of commerce. Two or three such collections were made each year.

M. E. Eaton del.

1. Upper part of flowering joint of *Nopalea cochenillifera*.
2. Upper part of flowering joint of *Nopalea auberi*.
3. Fruit of *Nopalea auberi*.
4. Flowering joint of *Nopalea dejecta*.

(All natural size.)

The cactuses upon which the cochineal was raised were often grown in large plantations called nopalries, sometimes containing 50,000 plants in rows about 4 feet apart.

Since the introduction of the aniline dyes, the cochineal industry has almost disappeared. The cochineal colors, while brilliant and attractive, are not very permanent.

According to J. J. Johnson, this plant was introduced into cultivation in England, in 1688; but according to Ray it was growing in Chelsea before that time.

Illustrations: Hernandez, Nov. Pl. Hist. 78 and 479. f. 1. 1651, as Nopalnochetzli; Andrews, Bot. Rep. 8: pl. 533; Curtis's Bot. Mag. 54: pl. 2741, 2742; Descourtilz, Fl. Piet. Antilles 7: pl. 516, all as *Cactus cochenillifer.* Cycl. Amer. Hort. Bailey 1: 205. f. 308; Gard. Chron. III. 34: 92. f. 41; Pfeiffer and Otto, Abbild. Beschr. Cact. 1: pl. 24, all as *Opuntia cochenillifera;* Förster, Handb. Cact. ed. 2. f. 3, as *Opuntia coccifera;* Dillenius, Hort. Elth. pl. 297, as tuna, etc.; Agr. Gaz. 25: pls. opp. p. 884; Amer. Garden 11: 457; Martius, Fl. Bras. 4^2: pl. 60. Schumann Gesamtb. Kakteen f. 109, B.

Plate IV, figure 1, shows a plant which flowered in the New York Botanical Garden in 1912.

2. Nopalea guatemalensis Rose, Smiths. Misc. Coll. 50: 330. 1907.

Tree-like, 5 to 7 meters high, branched, sometimes nearly to the base; joints bluish green, ovate to oblong, 15 to 20 cm. long; areoles numerous, filled with short white wool; spines 5 to 8, unequal, nearly or quite porrect, white or sometimes rose-colored, the longest 2.5 to 3 cm. long; leaves small, linear, reflexed; flower, including ovary, 5 to 6 cm. long; sepals ovate, thickened; petals red; fruit 4 to 5 cm. long, clavate, red, more or less tuberculate, deeply umbilicate, without prominent glochids; seeds irregular, 4 mm. broad.

Type locality: El Rancho, Guatemala.

Distribution: Arid valleys of Guatemala.

Illustrations: Safford, Ann. Rep. Smiths. Inst. 1908: f. 13, 14; Smiths. Misc. Coll. 50: pl. 41, 42.

Figure 39 illustrates joints of a plant obtained from Frank Weinberg in 1910.

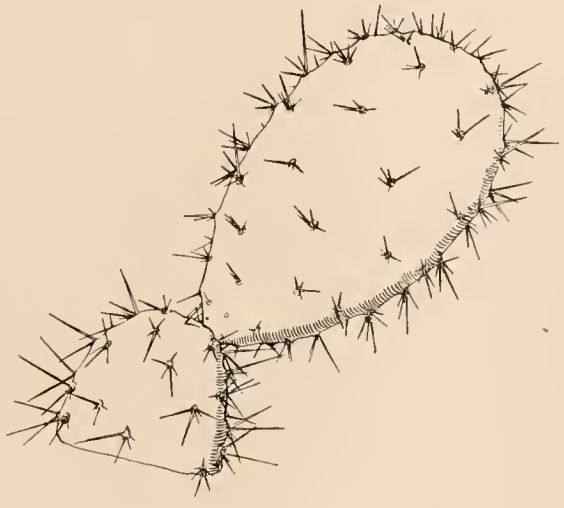


FIG. 39.—Nopalea guatemalensis. ×0.4.

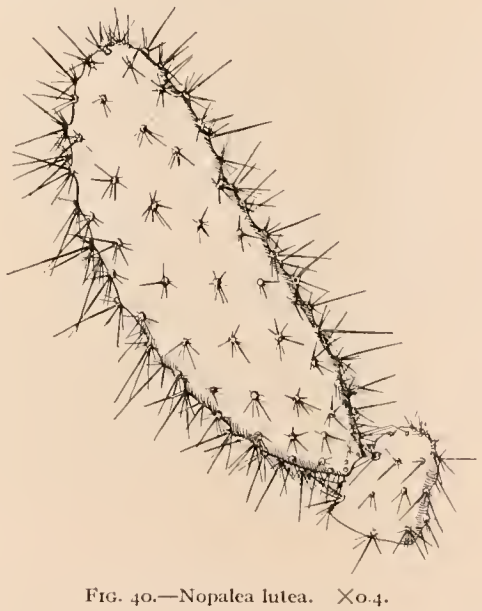


FIG. 40.—Nopalea lutea. ×0.4.

3. Nopalea lutea Rose, Contr. U. S. Nat. Herb. 12: 405. 1909.

More or less arborescent, 5 meters high or less, with a short, definite trunk and several large, lateral, more or less spreading branches; joints obovate to elliptic or oblong, 10 to 22 cm. long, pale green, slightly glaucous; areoles about 2 cm. apart, large, filled with short brown wool; spines weak, yellow, acicular or bristle-like, the longest 4 cm. long; flowers 5 cm. long; petals red, 2 cm. long;

ovary with numerous prominent areoles filled with yellow bristles; fruit red, 4 cm. long; seeds 4 to 5 mm. in diameter.

Type locality: Near El Rancho, Guatemala.

Distribution: Guatemala, Honduras, and Nicaragua.

This species, although not discovered until 1907, is very common, extending from altitude 300 meters at El Rancho to altitude 1,100 meters near Aguas Calientes. Accord-

FIG. 41.—Nopalea dejecta

ing to Mr. Charles C. Deam, who has explored extensively in Guatemala, the plant when growing on river sand-bars is low, but in rich soil is tall.

Our reference of this species to Nicaragua is based on a specimen collected by A. S. Oersted in 1845–1848 between Granada and Tipitapa. The joints of this, however, are nearly orbicular or a little longer than broad, with numerous brown spines and glochids. More material may show that this specimen should be referred elsewhere.

Illustration: Contr. U. S. Nat. Herb. 12: pl. 58.

Figure 40 shows a joint of a plant from Guatemala, received from F. Eichlam in 1911.

3*a*. **Nopalea gaumeri** sp. nov. (See Appendix, p. 216.)

4. **Nopalea auberi** (Pfeiffer) Salm-Dyck, Cact. Hort. Dyck. 1849. 64. 1850.

Opuntia auberi Pfeiffer, Allg. Gartenz. 8: 282. 1840.

Often 8 to 10 meters high, with a cylindric, jointed trunk, never very spiny, but the areoles bearing tufts of brown glochids; branches often at right angles to the stem; joints narrow, thick, 3 dm. long, bluish green and glaucous; areoles circular, about 2 mm. broad, bearing short white wool and later a tuft of brown glochids; spines, when present, 1 or 2, subulate, the upper one about twice as long as the other, white or nearly so, with brownish tips, the longest one 2 to 3 cm. long; flowers from base of ovary to tip of style about 9 cm. long; petals erect, closely embracing the stamens, rose-pink, ovate-lanceolate, acuminate, 2 to 3.5 cm. long; filaments 12 to 15 mm. longer than the petals, white below, but the exposed parts pinkish; anthers dehiscing before maturing of stigma; style stout, light pink with a large, white, circular disk just above the constricted base; stigma-lobes green; ovary 4 cm. long, with low but very distinct tubercles and a deep umbilicus, its areoles bearing many brown glochids, these sometimes 10 mm. long.

Fig. 42.—Nopalea dejecta. ×0.33

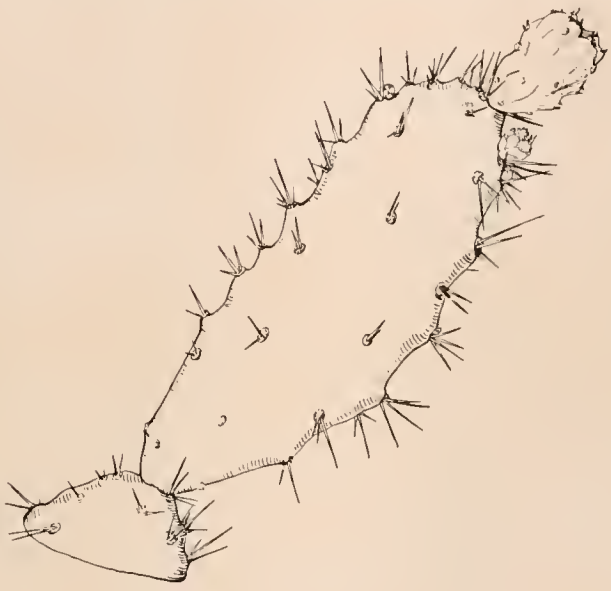


Fig. 43.—Nopalea karwinskiana. ×0.5

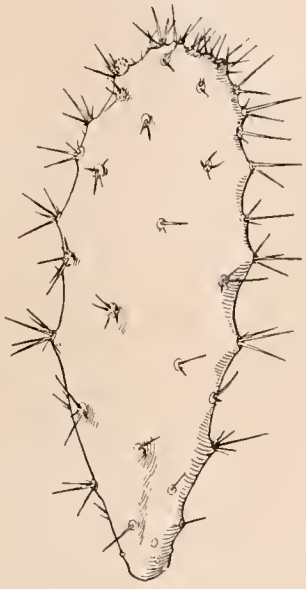


Fig. 44.—Nopalea inaperta. ×0.5.

Type locality: Erroneously cited as Cuba.

Distribution: Central and southern Mexico.

Illustration: Addisonia 1: pl. 10.

Plate IV, figure 2, represents a flowering joint of a plant obtained by W. E. Safford at Guadalajara, Mexico, in 1907; figure 3 shows young fruit of the same plant; plate V is from a photograph taken by Dr. MacDougal near Mitla, Mexico, in 1906.

5. **Nopalea dejecta** Salm-Dyck, Cact. Hort. Dyck. 1849. 64. 1850.

Opuntia dejecta Salm-Dyck, Hort. Dyck. 361. 1834.

Plant 1 to 2 m. high, with a definite trunk, very spiny, the old areoles often bearing 6 or 8 spines; joints narrow, 10 to 15 cm. long, only moderately thick, often drooping, bright green even in age, bearing usually two somewhat spreading spines at an areole; spines at first pale yellow or pinkish, in age gray, the longest 4 cm. long; flower, including ovary and style, 5 cm. long; sepals obtuse; petals erect, dark red; stamens long-exserted, dark red.

Type locality: Erroneously cited as Havana, Cuba.

Distribution: Common in cultivation in tropical America; perhaps native in Panama.

Opuntia diffusa and *O. horizontalis* are both given by Pfeiffer (Enum. Cact. 159. 1837) as synonyms of this species.

Illustrations: Agr. Gaz. N. S. W. **25**: pl. opp. p. 138; Roig, Cact. Fl. Cub. pl. [6], this last as *Nopalea auberi*.

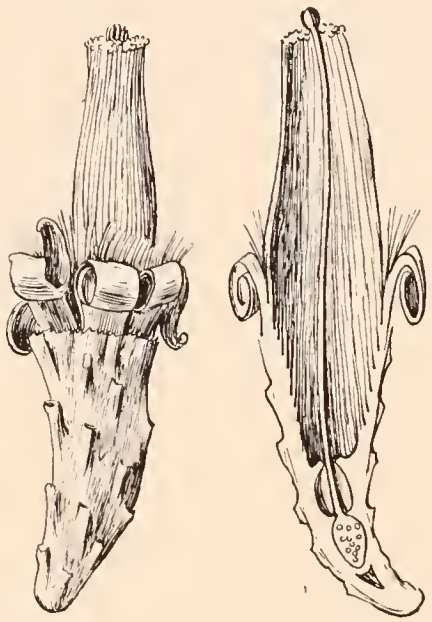
Plate IV, figure 4, shows a flowering joint of a plant obtained from Mr. S. F. Curtis in 1897. Figure 41 is from a photograph taken by Dr. Juan T. Roig in the Havana Botanical Garden, Cuba; figure 42 shows a joint of a plant collected by Mr. J. F. Cowell at Panama in 1905.

6. **Nopalea karwinskiana** (Salm-Dyck) Schumann, Gesamtb. Kakteen 752. 1898.

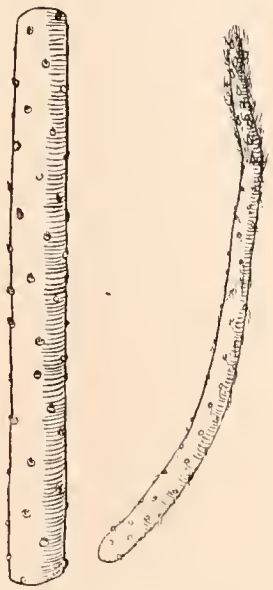
Opuntia karwinskiana Salm-Dyck, Cact. Hort. Dyck. 1849. 239. 1850.

A tree, 2 meters high or more, with a definite jointed terete spiny trunk; joints oblong, 1.5 to 3 dm. long, light dull green, only slightly glaucous; leaves elongated, acute; areoles distant; spines 3 to 7 from an areole, porrect, 1 to 2 cm. long, pale yellow to nearly white; glochids yellow, numerous, caducous; flowers red, 11 to 12 cm. long; ovary deeply umbilicate, 3 cm. long.

Type locality: In Mexico.
Distribution: Mexico.



FIGS. 45, 46.—Flower of Tacinga funalis. ×0.9. Drawing by A. Löfgren.



FIGS. 47, 48.—Tacinga funalis. ×0.6.

This species was sent from Mexico by Karwinsky, who supposed it was an *Opuntia*. When described by Salm-Dyck in 1850 it had not flowered. It was re-collected by Edmund Kerber near Colima, Mexico, and flowered for the first time in cultivation in 1879.

Our description is drawn chiefly from a plant now in the New York Botanical Garden, obtained from M. Simon, of St. Ouen, Paris, France. In the original description it is stated that the young spines are 2 to 4 and rose-colored, but afterwards 18 to 20, gray and deflexed. *O. nopalilla* Karwinsky (Salm-Dyck, Cact. Hort. Dyck. 1849. 68. 1850) was first given as a synonym of this species.

Figure 43 represents a joint with young fruit, from a plant sent by M. Simon, St. Ouen, Paris, France, in 1901.

7. **Nopalea inaperta** Schott in Griffiths, Monatsschr. Kakteenk. **23**: 139. 1913.

Described as 5 to 7 meters high, but in cultivation much smaller, diffusely branched, often bush-like; trunk very spiny; terminal joints rather small, obovate, 6 to 17 cm. long, strongly tuberculate, bright green; spines usually 3 to 6 at areoles of young joints, more at old ones, yellowish

Nopalea auberi as it grows near Mitla, Mexico.
Photograph by D. T. MacDougal.

brown, 2 cm. long or less; flowers rather small, including ovary and stamens 4 cm. long; filaments numerous, long-exserted; style much longer than the stamens; stigma-lobes 5, green; fruit small, red, 1.5 cm. long.

Type locality: In Yucatán, Mexico.

Distribution: Yucatán.

Dr. Griffiths states that he found this species in the Albert S. White Park, Riverside, California, in 1904. In the Bulletin of the New Mexico Agricultural Experiment Station No. 60 he describes and illustrates it, but without specific name. Later he identified it as the same as one of Schott's specimens from Yucatán, and then published it as above.

Dr. Griffiths compares it with *N. auberi*, but its nearest relative is *N. karwinskiana*, from which it differs in its smaller and more tuberculate joints and much smaller flowers.

Illustration: N. Mex. Agr. Exp. Sta. Bull. 60: pl. 3, f. 1, as *Nopalea*.

Figure 44 shows a joint from a plant obtained by Dr. David Griffiths at Riverside.

4. **TACINGA** gen. nov.

Long, clambering or climbing cacti, more or less branched; old stems smooth, brown; branches faintly ribbed, terete; young branches green, each tipped with a tuft of long wool or soft hairs; areoles small but conspicuous, black, the margin giving off long, white, cobwebby hairs; leaves minute, soon deciduous, 3 to 4 mm. long; spines sometimes present, on young joints 2 or 3, reflexed, appressed, brown, 2 to 3 mm. long, not seen on old branches; glochids from the upper parts of the areoles, pale yellow, numerous, caducous, falling in showers at the slightest jarring of the branch; flower-buds acute; flowers usually terminal, opening in the evening or at night; ovary narrow, bearing numerous areoles, the umbilicus very deep; petals few, spreading or recurved; a row of hairs between the petals and the stamens; stamens and style erect, much longer than the petals; fruit oblong, the upper half sterile, bearing areoles but no spines; seeds nearly globular, white, covered with a bony aril.

This genus is intermediate between *Opuntia* and *Nopalea*, having the erect, non-sensitive stamens of the latter, and the areoles, leaves, and glochids of the former. From *Opuntia* it differs in its narrow, green, recurved petals, in having one or possibly more rows of hairs between the stamens and the petals, in the clambering or climbing habit, and its very caducous glochids.

Only one species is known, this a common and characteristic plant of the catinga* in Bahia, Brazil, whence the anagramatic name.

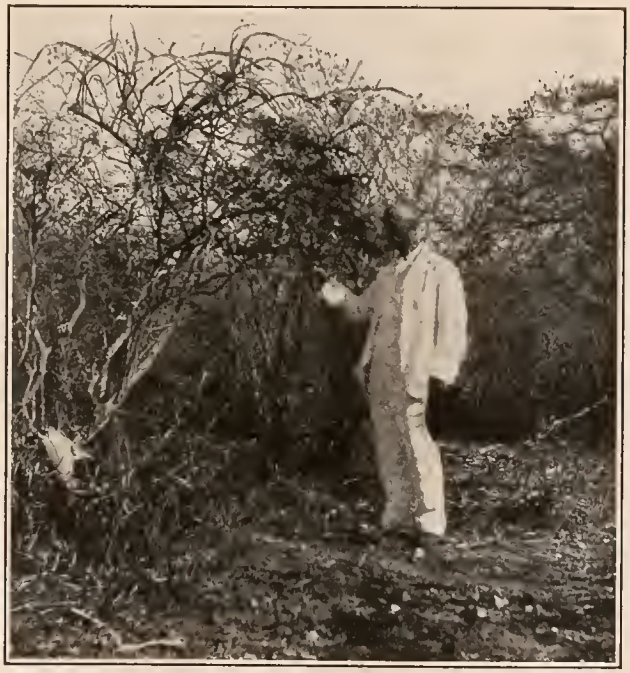


Fig. 49.—Tacinga funalis. Showing how it climbs over bushes.

1. **Tacinga funalis** sp. nov.

At first erect, then climbing over shrubs or through trees, 1 to 12 meters long, somewhat branching; old stems woody, slender; branches usually reddish, the areoles borne on low ribs; glochids short; flower, including ovary, 7 to 8 cm. long; sepals about 10, short, ovate, acute, 5 to 15 mm. long; petals about 7, green, 4 cm. long, acute, revolute; stamens erect, connivent, not sensitive; anthers narrow, elongated; style elongated, thread-like, most slender below, a little longer than the stamens, 4.5 cm. long, cream-colored; stigma-lobes 5, green; fruit 4 to 5 cm. long; seeds 3 to 4 mm. broad.

* Catinga or caatinga is the common Brazilian name for the thorn-bush desert region in Bahia, Brazil. Dr. Albert Löfgren says that the name (best spelled caatinga) is of Indian origin, meaning caa = wood, forest; tinga = white, clear; a forest in which one can see far.

Common in the dry parts of Bahia, Brazil, where it was collected by Rose and Russell in 1915 (No. 19723, type). Dr. Zehntner thinks there may be a second species, as he has found one with purple flowers; specimens from southern Bahia had purple buds, but the open flowers were not seen. The type comes from Joazeiro, northern Bahia.

Dr. Rose studied this species in the field and believed it to be new. On reaching Rio de Janeiro, he found that Dr. A. Löfgren had also studied it, referring it, however, to *Opuntia*, using the above specific name.

Figures 45 and 46 are copied from drawings of the flowers given to Dr. Rose by Dr. Löfgren; figures 47 and 48 are from twigs of the plant grown at the New York Botanical Garden; figure 49 is from a photograph of the type plant.

5. MAIHUENIA Philippi, Gartenflora 32: 260. 1883.

Plants low, cespitose, often forming small, dense mounds; stems jointed; joints small, globular or short-cylindric; leaves small, usually terete, persistent; leaves of seedlings terete, ascending, with 2 long white bristles in the axils; areoles filled with white wool; spines 3, the central one elongated, the 2 lateral ones small and very short; glochids wanting; flowers large for the size of the plant, yellow or red, usually terminal; petals distinct; flower-tube none; stamens and style much shorter than the petals; fruit juicy (described as dry in one species), oblong to obovoid, bearing small scattered, ovate, persistent leaves; wall of fruit thin; cotyledons linear; seed black, shining, with a brittle testa.

FIG. 50.—Maihuenia valentinii.

Type species: *Opuntia poeppigii* Otto.

There are five species described, rather closely related, natives of the high mountains of Chile and Argentina.

The generic name is derived from maihuen, the native name of the plant.

This is a small, localized genus; it is perhaps nearest *Opuntia*, but is without glochids and has different seeds. The first species was described in 1837, and a second in 1864, both as *Opuntia*. Weber in 1898 transferred them to *Pereskia*, proposing a new subgenus for them, but they are much less like *Pereskia* than *Opuntia*, for, except as to the seeds, they have little in common with *Pereskia;* in habit, leaves, spines, flowers, and fruits they are quite unlike any of the pereskias.

Key to Species.

Joints subglobose ..... 1. *M. patagonica*
Joints oblong to cylindric.
  Leaves linear, 4 to 6 mm. long ..... 2. *M. poeppigii*
  Leaves ovate to subulate, 2 to 4 mm. long.
    Joints spineless below ..... 3. *M. brachydelphys*
    Joints spiny all over.
      Leaves on the ovary with white hairs in their axils ..... 4. *M. valentinii*
      Leaves on the ovary without hairs in their axils ..... 5. *M. tehuelches*

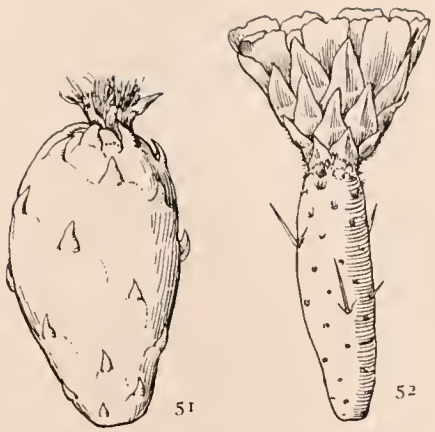


Fig. 51.—Maihuenia poeppigii. ×0.75.
Fig. 52.—Maihuenia brachydelphys. ×0.75.

1. Maihuenia patagonica (Philippi).

Opuntia patagonica Philippi, Linnaea 33: 82. 1864.
Pereskia philippii Weber, Dict. Hort. Bois 939. 1898.
Maihuenia philippii Weber in Schumann, Gesamtb. Kakteen 757. 1898.

Low, much branched, and dense, resembling *Sempervivum tomentosum* in habit; joints subglobose, 1 to 1.5 cm. in diameter; leaves subulate, green; young areoles bearing white hairs; spines weak, hardly pungent, white, the longest 10 to 15 mm. long; flowers 2.8 to 3 cm. long; fruit 8 to 10 mm. long, thicker than long; leaves on the ovary ovate to lanceolate, fleshy, naked in their axils, except some of the upper ones; seeds round, 3 to 4 mm. in diameter.

Type locality: In southern Argentina.

Distribution: Near snow-line on southern mountain ranges of Argentina and Chile.

Opuntia philippii Haage and Schmidt, without description, is given by Weber (Dict. Hort. Bois 939. 1898) as a synonym of this species.

This is called by the natives espina blanca.

2. Maihuenia poeppigii (Otto) Weber in Schumann, Gesamtb. Kakteen 755. 1898.

Opuntia poeppigii Otto in Pfeiffer. Enum. Cact. 174. 1837.
Opuntia maihuen Remy in Gay, Fl. Chilena 3: 29. 1847.
Pereskia poeppigii Salm-Dyck, Cact. Hort. Dyck. 1849. 252. 1850.

Shrubby, much branched, prostrate, forming dense cespitose masses 1 meter broad; joints spiny to the bases, cylindric, 6 cm. long or more, 1.5 cm. in diameter; leaves cylindric, green, 4 to 6 mm. long; spines 3 from each areole, the 2 laterals very short, the central one 1.5 to 2 cm. long; flowers terminal, yellow; fruit oblong to obovoid, about 5 cm. long and 3 cm. thick.

Type locality: In Chile, without definite locality.

Distribution: High mountains of Chile.

Illustrations: Schumann, Gesamtb. Kakteen f. 108, B, C.; Gartenflora 32: pl. 1129, f. 1 to 4, as *Opuntia poeppigii*; Dict. Gard. Nicholson 3: f. 82, as *Pereskia poeppigii*.

Figure 51 is from a fruit obtained by Dr. Rose at the National Museum of Chile, Santiago, in 1914.

Fig. 53.—Maihuenia tehuelches

3. **Maihuenia brachydelphys** Schumann, Gesamtb. Kakteen 756. 1898.

Cespitose, prostrate; joints cylindric or nearly ellipsoid, naked below, 2 cm. long; spines 2 or 3, one much stouter and longer, yellow except at base and there brown; leaves terete, 2 to 3 mm. long; areoles circular, full of white wool; flowers usually from the tips of joints, red, 3.5 cm. long.

Type locality: Paseo Cruz, Argentina, 34° south latitude, province of Mendoza.
Distribution: Western Argentina.
Opuntia brachydelphys Schumann is mentioned by Kuntze (Rev. Gen. Pl. 3^2: 107. 1898) by name only.
Illustration: Schumann, Gesamtb. Kakteen f. 108, A.
Figure 52 is copied from Schumann's illustration above cited.

4. **Maihuenia valentinii** Spegazzini, Anal. Mus. Nac. Buenos Aires II. 4: 289. 1902.

Shrubby, 1 to 2.5 dm. high, dull green; joints cylindric, somewhat clavate, 1 to 3.5 cm. long; leaves ovate, small; spines 3, the central much larger, 2 to 6 cm. long; flowers from near the ends of the branches, 2 cm. broad, the sepals reddish, the petals white to light yellow; stamens indefinite; filaments white; style 6 mm. long, white, longer than the stamens; stigma-lobes 5, short, 2 mm. long, purplish; ovary globular to obconic, 5 to 8 mm. long, bearing numerous triangular fleshy leaves with long white hairs and sometimes 1 or 2 spines in their axils; fruit unknown.

Type locality: Near Trelew, Chubut, Argentina.
Distribution: Territory of Chubut, southern Argentina.
Related to *M. tehuelches* and *M. poeppigii*, but said to be very distinct.
Figure 50 is from a photograph furnished by Dr. Carlos Spegazzini.

5. **Maihuenia tehuelches** Spegazzini, Anal. Mus. Nac. Buenos Aires II. 4: 288. 1902.

Shrubby, 2 to 3 dm. high, with many intricate branches, dull green; joints cylindric, ellipsoid to somewhat clavate, 2 to 8 cm. long by 10 to 12 cm. in diameter; leaves ovate, small, 2 to 4 mm. long; spines 3, the central one erect, 2 to 4 cm. long, the 2 lateral ones only 5 to 10 mm. long; flowers at the apex of the branches, 35 to 45 mm. broad, white to yellowish white; fruit globose, naked, dry, 2 cm. in diameter; seeds black, 3 mm. broad.

Type locality: Between San Julián and Río Deseado, Argentina.
Distribution: Dry, rocky deserts, southwestern Argentina.
Figure 53 is from a photograph furnished by Dr. Carlos Spegazzini.

6. OPUNTIA (Tournefort) Miller, Gard. Dict. Abridg. ed. 4. 1754.

Cactodendron Bigelow, Pac. R. Rep. 3: 102; 4: 7, 11, iii. 1856.
Consolea Lemaire, Rev. Hort. 1862: 174. 1862.
Tephrocactus Lemaire, Cact. 88. 1868.
Ficindica St. Lager, Ann. Soc. Bot. Lyon 7: 70. 1880.

Cacti, sometimes with definite trunks, or more often much branched from the base, the branches often spreading, reclining, or prostrate, sometimes clambering, but never climbing (one species known with annual stems); roots fibrous or rarely tuberous and large and fleshy; ultimate branches (joints or pads) cylindric to globose or flattened, usually very fleshy, sometimes woody; areoles axillary, bearing spines, barbed bristles (glochids), hairs, flowers, and sometimes glands; leaves usually small, terete, mostly early deciduous; spines solitary or in clusters, terete or flattened, naked or sheathed, variously colored; glochids usually numerous, borne above the spines; flowers usually one at an areole; ovary inferior, one-celled, many-ovuled, bearing leaves, the areoles often with spines and glochids; sepals green or more or less colored, usually grading into the petals; petals usually of various shades and combinations of green, yellow, and red (rarely white), widely spreading; stamens much shorter than the petals, sensitive; style single, thick; stigma-lobes short; fruit a berry, dry or juicy, often edible, spiny or naked, globular, ovoid or ellipsoid; seed covered by a hard, bony aril, white, flattened; embryo curved; cotyledons 2, large.

The species grow naturally from Massachusetts to British Columbia south to the Strait of Magellan. Several have been naturalized and have become very abundant locally in the Old World and in Australia.

The type species is *Cactus opuntia* Linnaeus.

Karl Schumann recognized 131 species in his "Gesamtbeschreibung der Kakteen," published during the years 1897 and 1898. Many have been described since this monograph was published.

The name Opuntia was that of a town in Greece, where some cactus-like plant is said to have grown.

The genus is important economically. It furnishes the well-known tuna fruit largely imported into our eastern cities from Italy and which is common in the markets of Mexico. Some species are used for hedges, the branches of others are cooked like spinach, and still others furnish forage for stock.

The species are numerous and very diverse, and have at various times been grouped by authors into several genera, while other species, now referred by us to *Nopalea*, *Maihuenia*, and *Pereskiopsis*, were included in *Opuntia*.

The following genera now referred to *Opuntia* have been regarded as distinct from it:

Consolea was described by Lemaire in 1862. He described five species, of which *C. rubescens* is the first and therefore the type. This group is a striking one, characterized by a pronounced cylindric trunk in old plants, with an unjointed central woody axis, peculiar semaphore-like branches at the top, and very small flowers. There are eight species of this group, described under our series *Spinosissimae*. They are confined to the West Indies, although *C. rubescens*, the spineless race of *Opuntia catacantha*, was originally described as from Brazil—doubtless erroneously.

Tephrocactus was described by Lemaire in 1868, and to it he referred eight species of *Opuntia*. *T. diadematus* is the type species. Schumann included it in *Opuntia* as a subgenus, with 15 species. They are all South American, chiefly in Argentina and Bolivia.

Ficindica was established by St. Lager in 1880, based on *Opuntia ficus-indica*, which is clearly congeneric with *Opuntia opuntia*.

In 1856 the name *Cactodendron* was proposed in an account of Whipple's Expedition, published in volumes 3 and 4 of the Pacific Railroad Reports. It was apparently not intended to be a formal publication, but as a definite species is indicated, the name is published. It will be of interest to record here the evidence upon which we reach this conclusion:

Cactodendron Bigelow Pac. R. Rep. 3: 102; 4: 7, 11; Additional Notes and Corrections iii. 1856.

"There are * * * *Opuntia* of many varieties; some with wide leaf-like joints, others of shrubby form and woody fibre, which the botanist proposes to name *Cactodendron*." Pac. R. Rep. 3: 102.

"Immediately on our entrance into this valley (November 19 [1856]) we found and collected a new species of *Opuntia*, with prostrate, nearly terete joints, entirely devoid of woody fibre; * * *. Lieutenant Whipple discovered the first specimen of our new *Cactodendron*, as we were pleased to call it, to distinguish it from the *O. arborescens*." Pac. R. Rep. 4: 7.

"The arborescent *Opuntia*, first found near Zuni, which, to distinguish from the true *O. arborescens*, we called *Cacto-dendron*, finds its western limits near the termination of this region." Pac. R. Rep. 4: 10.

"15. 'New arborescent *Opuntia*,' called also 'our new *Cactodendron*,' pages 7 and 11, is *Opuntia whipplei*, E. & B., new species." Pac. R. Rep. 4: Additional Notes and Corrections iii.

Opuntias are known under a great variety of names. Among the names for the flat-jointed species, the most common are: prickly pear in the United States; tuna in Mexico; sucker and bullsucker in the Lesser Antilles. For the round-stemmed forms we have: cane cactus, and such Mexican names as cholla and tasajo. Dr. David Griffiths has published a list of names used in Mexico.

The genus *Opuntia*, as understood by us, is composed of at least 250 species, but more than 900 names are to be found in literature. No type specimens of many of the species

were preserved by their authors, some have, apparently, been lost, and some, which are probably preserved, we have been unable to study.

The genus shows a great range in stem structure, varying from cylindric to broad and flat. These extremes suggest different generic types, but these characters can not be used except in the most general way, for some species have both rounded and flattened stems. Some with round stems have flowers which suggest a closer relationship with the species with flattened stems.

The habits of some of the species are very characteristic, while others show a wide range of forms. Many of the erect or tree-like forms, when grown from cuttings, develop bushy habits much unlike their normal shapes.

The spines, while somewhat constant in color in some species, vary considerably in others, and the number of spines is rather inconstant. Species which are normally abundantly spined are sometimes naked when cultivated, while species which are normally naked sometimes develop spines in cultivation; cultivated specimens usually have weaker spines and sometimes decidedly different ones from wild plants.

The flowers often vary greatly in color, as is seen especially in *O. versicolor* and *O. lindheimeri*, which show wide ranges of color forms. Some flowers vary in color during the day.

We group the species known to us into 3 subgenera, 46 series, and with the following characteristics:

Key to Subgenera and Series of Opuntia.

A. Joints all terete, elongated or short, cylindric to globose.
- B. Branches several, many-jointed ..... Subgenus 1. Cylindropuntia
  - C. Spines with papery sheaths.
    - D. Spines, at least some of them, solitary, sometimes several, acicular; ultimate branches slender, rarely more than 1 cm. thick.
      - E. Stem and branches conspicuously marked by flattened, diamond-shaped tubercles; fruit dry, covered with long bristle-like spines ..... Series 1. *Ramosissimae* (N. A.)
      - EE. Tubercles not flattened nor diamond-shaped; fruit usually a naked berry ..... Series 2. *Leptocaules* (N. A.)
    - DD. Spines always more than 1; ultimate branches stouter.
      - E. Ultimate branches not over 2 cm. thick ..... Series 3. *Thurberianae* (N. A.)
      - EE. Ultimate branches 2 cm. thick or more.
        - F. Fruit dry ..... Series 4. *Echinocarpae* (N. A.)
        - FF. Fruit fleshy.
          - G. Tubercles of young joints scarcely longer than broad. Series 5. *Bigelovianae* (N. A.)
          - GG. Tubercles distinctly longer than broad.
            - H. Tubercles narrow, high, laterally flattened ..... Series 6. *Imbricatae* (N. A.)
            - HH. Tubercles broad, low ..... Series 7. *Fulgidae* (N. A.)
  - CC. Spines without sheaths.
    - D. Joints not tuberculate, or with broad or flat tubercles.
      - E. Areoles long-woolly or with weak hairs (without hairs in *O. verschaffeltii*) ..... Series 8. *Vestitae* (S. A.)
      - EE. Areoles neither long-woolly nor long-hairy.
        - F. Joints clavate or crested ..... Series 9. *Clavarioides* (S. A.)
        - FF. Joints neither clavate nor crested.
          - G. Low, slender species, scarcely, if at all, tuberculate .. Series 10. *Salmianae* (S. A.)
          - GG. Tall, stout species, the tubercles broad or flat; leaves large ..... Series 11. *Subulatae* (S. A.)
    - DD. Joints strongly tuberculate, the tubercles elevated.
      - E. Tall, shrubby species; joints cylindric ..... Series 12. *Miquelianae* (S. A.)
      - EE. Low, prostrate species; joints clavate (transition to *Tephrocactus*) ..... Series 13. *Clavatae* (N. A.)
- BB. Branches 1 to few-jointed, the short joints usually clustered .... Subgenus 2. Tephrocactus (S. A.)
  - C. Joints, at least some of them, cylindric, tuberculate, the tubercles contiguous (transition to *Cylindropuntia*) Series 1. *Weberianae*
  - CC. Joints globose to oblong, mostly little, if at all, tuberculate.
    - D. Areoles normally bearing many long white hairs, which often cover the whole plant ..... Series 2. *Floccosae*
    - DD. Areoles without hairs.
      - E. Spines, when present, at least some of them, modified into flat, papery processes ..... Series 3. *Glomeratae*
      - EE. Spines, when present, all subulate or acicular, terete or somewhat flattened ..... Series 4. *Pentlandianae*

Key to Subgenera and Series of Opuntia—continued.

AA. At least some of the joints flat or compressed ..... Subgenus 3. Platyopuntia
B. Stems perennial, stout or slender.
C. Plants branching from near or at the base, not forming erect, cylindric unjointed trunks; flowers mostly large.
D. Epidermis glabrous or pubescent, not papillose-tuberculate when dry.
E. Flowers perfect; petals obovate to oblong.
F. Fruit a juicy berry (exceptions in Series 5, *Basilares*).
G. Joints readily detached.
H. Joints very readily detached; low, mostly small-jointed species.
I. Joints little flattened, subterete (transition to *Cylindropuntia*) ..... Series 1. *Pumilae* (N. A.; S. A.)
II. At least the ultimate joints distinctly flattened.
J. Ultimate joints or all joints turgid ..... Series 2. *Curassavicae* (N. A.; S. A.)
JJ. Ultimate joints flat and thin ..... Series 3. *Aurantiacae* (S. A.)
HH. Joints less readily detached; mostly taller and larger-jointed species ..... Series 4. *Tunae* (N. A.; S. A.)
GG. Joints not readily detached, persistent.
H. Areoles small, 1 to 2 mm. in diameter, not elevated, mostly close together ..... Series 5. *Basilares* (N. A.)
HH. Areoles larger, mostly distant.
I. Prostrate or spreading species; joints relatively small. (*O. austrina* suberect.)
J. Joints not tuberculate.
K. Flowers small, brick-red ..... Series 6. *Inamoenae* (S. A.)
KK. Flowers large, yellow ..... Series 7. *Tortispinae* (N. A.)
JJ. Joints strongly tuberculate ..... Series 8. *Sulphureae* (S. A.)
II. Bushy, depressed or tall species.
J. Spines, when present, brown or yellow (white in *O. setispina*).
K. Spines brown, at least at the base or tip.
L. Bushy or depressed species.
M. Fruit very small ..... Series 9. *Strigiles* (N. A.)
MM. Fruit large.
N. Spines acicular ..... Series 10. *Setispinae* (N. A.)
NN. Spines subulate ..... Series 11. *Phaeacanthae* (N. A.)
LL. Tall species, sometimes with a definite trunk (*O. galapageia* sometimes depressed).
M Spines several at each areole ..... Series 12. *Elatiores* (N. A.; S. A.)
MM. Spines, when present, 1 to few at each areole ..... Series 13. *Elatae* (S. A.)
KK Spines, if any, yellow, at least partially.
L. Epidermis glabrous.
M. Areoles close together, bearing long brown wool ..... Series 14. *Scheerianae* (N. A.)
MM. Areoles distant, without long wool. Series 15. *Dillenianae* (N. A.)
LL. Epidermis, at least that of the ovary, pubescent ..... Series 16. *Macdougalianae* (N. A.)
JJ. Spines, when present, white (or faintly yellow).
K. Epidermis pubescent.
L. Spines, when present, acicular ..... Series 17. *Tomentosae* (N. A.)
LL. Spines several, setaceous, flexible ..... Series 18. *Leucotrichae* (N. A.)
KK. Epidermis glabrous.
L. Areoles bearing long, soft hairs ..... Series 19. *Orbiculatae* (N. A.)
LL. Areoles without long hairs.
M. Joints green or bluish green.
N. Spineless, or with few, usually short, spines ..... Series 20. *Ficus-indicae* (N. A.; S. A.)
NN. Spiny, at least old joints so ..... Series 21. *Streptacanthae* (N. A.; S. A.)
MM. Joints blue ..... Series 22. *Robustae* (N. A.)
FF. Fruit dry, not juicy ..... Series 23. *Polyacanthae* (N. A.)
EE. Flowers dicœcious; petals very narrow ..... Series 24. *Stenopetalae* (N. A.)
DD. Epidermis densely papillose-tuberculate when dry ..... Series 25. *Palmadorae* (S. A.)
CC. Plants with erect, unjointed trunks, the branches with flat joints; flowers mostly small.
D. Flowers small; joints spreading.
E. Joints all flat, relatively thick ..... Series 26. *Spinosissimae* (N. A.)
EE. Some joints terete, others flat and very thin ..... Series 27. *Brasilienses* (S. A.)
DD. Flowers large; joints ascending ..... Series 28. *Ammophilae* (N. A.)
BB. Stems annual, very slender ..... Series 29. *Chaffeyanae* (N. A.)

Subgenus 1. CYLINDROPUNTIA.

Includes the many-jointed species in which none of the joints is at all flattened.

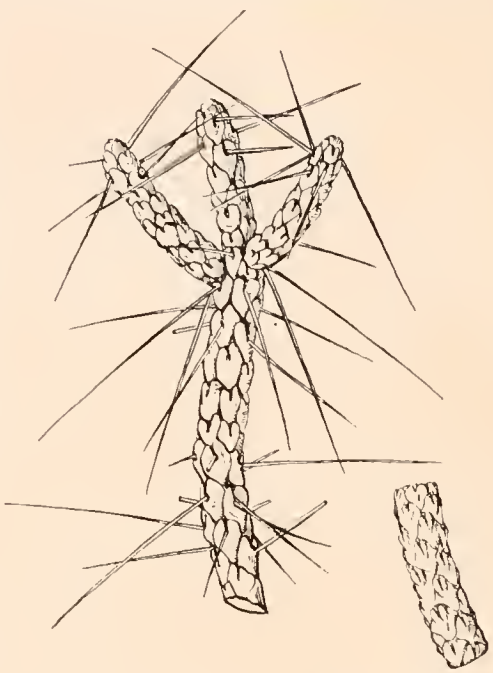
Series 1. RAMOSISSIMAE.

The series consists of a single bushy species, with slender joints, the nearly flat tubercles diamond-shaped and contiguous, the acicular spines, when present, usually only 1 at an areole.

1. Opuntia ramosissima Engelmann, Amer. Journ. Sci. II. **14**: 339. 1852.

Opuntia tessellata Engelmann, Proc. Amer. Acad. **3**: 309. 1856.

Frutescent, bushy, sometimes 2 meters high, the branches gray, often widely spreading, and 9 cm. long; tubercles low, slightly convex, 4-angled to 6-angled, giving the surface an appearance of being covered with diamond-shaped plates; leaves ovoid, 1 to 3 mm. long, acute; areoles on young shoots circular, with white or tawny wool and pale glochids, the upper part in age compressed into the narrow slit between the two adjoining tubercles, the lower part depressed-linear, with a slightly elevated border; spines often wanting, but when present abundant, usually one at each areole, rarely 2, porrect, acicular, sometimes 6 cm. long, usually reddish when young, covered by loose, yellow, papery sheaths; flowers, including ovaries, 3 to 4 cm. long; sepals subulate, similar to the leaves of the ovary, but longer; petals greenish yellow, tinged with red, obovate, aristulate, about 1 cm. long; stamens greenish yellow; anthers orange-colored; style and stigma-lobes cream-colored; ovary narrowly obconic, covered with emarginate tubercles, the areoles bearing wool and long glochids, but no spines; fruit dry, obovate, 2 to 2.5 cm. long, covered with clusters of weak, slender spines, appearing like a bur; seeds few, white, 5 mm. broad.



FIGS. 54, 55.—Opuntia ramosissima. ×0.75.

Type locality: In California, near the Colorado River.

Distribution: Southern Nevada, western Arizona, southeastern California, northwestern Sonora and probably northeastern Lower California.

The flowers of this species have been described as purple, apparently erroneously.

This species is found in the most arid deserts of the southwestern part of the United States, usually growing on low hills, and is confined chiefly to the lower Colorado; it is here rather inconspicuous and might easily be overlooked. It is one of the least succulent species of the genus, the terminal shoots soon becoming hard, and hence the plant is difficult to propagate from cuttings, and is rarely found in greenhouse collections.

Opuntia tessellata cristata Schumann (Monatsschr. Kakteenk. **8**: 70. 1898) is a striking monstrosity which Schumann has described and figured.

Illustrations: Cact. Journ. 1: pl. [1]; Cycl. Amer. Hort. Bailey **3**: f. 1549; Pac. R. Rep. **4**: pl. 21; 24, f. 20, all as *Opuntia tessellata*.

Figure 54 represents a spiny branch drawn from a specimen sent by Mr. S. B. Parish from Barstow, California, in 1915; figure 55 shows a portion of an unarmed branch sent by the same collector from the same locality.

Series 2. LEPTOCAULES.

Bushy species, with slender joints, the ultimate ones 4 to 15 mm. thick, often readily detached; the flowers small.

Inhabitants of the southwestern United States, Mexico, northern South America, and one species in Santo Domingo.

Key to Species.

Ultimate joints short, usually at right angles to the branches, 4 to 7 mm. thick.
- Bushy plants, 1.5 meters high or less; fruit small, fertile.
  - Branches scarcely if at all tuberculate.
    - Leaves ovoid to ovoid-subulate; young areoles long-hairy ..... 2. *O. mortolensis*
    - Leaves linear; areoles not long-hairy ..... 3. *O. leptocaulis*
  - Branches long-tuberculate ..... 4. *O. tesajo*
- Elongated plants, up to 2 meters long; fruit larger, sterile ..... 5. *O. caribaea*

Ultimate joints longer, 8 to 15 mm. thick, usually at an acute angle to the branches.
- Joints only slightly tuberculate ..... 6. *O. arbuscula*
- Joints manifestly tuberculate ..... 7. *O. kleiniae*

2. Opuntia mortolensis sp. nov.

Slender, 6 dm. high or less, dull green, with dark blotches below the areoles, the ultimate twigs short, sometimes only 2 cm. long, 4 to 5 mm. thick, scarcely tuberculate; leaves ovate to ovate-subulate, 2 to 4 mm. long, green, with acute bronze-colored tips; young areoles with numerous, early deciduous, weak white hairs sometimes longer than the leaves, and several brown glochids; areoles of old branches with solitary acicular spines 3 to 5 cm. long, these with tightly fitting brownish sheaths; flowers and fruit unknown.

Described from No. 25360, New York Botanical Garden, received from the garden of Sir Thomas Hanbury, La Mortola, Italy, in 1906. Mr. Berger has referred this specimen to *Opuntia leptocaulis longispina*, but this was considered by Dr. Engelmann as the "usual western form" of *O. leptocaulis*.

An herbarium specimen collected by Rose, Standley, and Russell at Empalme, Sonora, Mexico, March 11, 1910 (No. 12644), appears to be referable to this species.

The short leaves and long-hairy young areoles appear to distinguish this plant from *O. leptocaulis*.

Illustration: Gard. Chron. III. 34: f. 37, as *Opuntia leptocaulis longispina*.

Plate VI, figure 1, represents a branch of a plant sent from La Mortola, Italy, in 1906; figure 2 shows a leafy twig of the same plant.

3. Opuntia leptocaulis De Candolle, Mém. Mus. Hist. Nat. Paris **17**: 118. 1828.

Opuntia ramulifera Salm-Dyck, Hort. Dyck. 360. 1834.
Opuntia gracilis Pfeiffer, Enum. Cact. 172. 1837.
Opuntia fragilis frutescens Engelmann, Bost. Journ. Nat. Hist. **5**: 245. 1845.
Opuntia virgata Link and Otto in Förster, Handb. Cact. 506. 1846.
Opuntia vaginata Engelmann in Wislizenus, Mem. Tour North. Mex. 100. 1848.
Opuntia frutescens Engelmann, Bost. Journ. Nat. Hist. **6**: 208. 1850.
Opuntia frutescens brevispina Engelmann, Proc. Amer. Acad. **3**: 309. 1856.
Opuntia frutescens longispina Engelmann, Proc. Amer. Acad. **3**: 309. 1856.
Opuntia leptocaulis brevispina S. Watson, Bibl. Index **1**: 407. 1878.
Opuntia leptocaulis vaginata S. Watson, Bibl. Index **1**: 407. 1878.
Opuntia leptocaulis stipata Coulter, Contr. U. S. Nat. Herb. **3**: 456. 1896.
Opuntia leptocaulis longispina Berger, Bot. Jahrb. Engler **36**: 450. 1905.

Usually bushy, often compact, 2 to 20 dm. high, but sometimes with a short, definite trunk 5 to 8 cm. in diameter, dull green with darker blotches below the areoles, with slender, cylindric, ascending, hardly tuberculate branches; branches, especially the fruiting ones, thickly set with short, usually spineless joints spreading nearly at right angles to the main branches, very easily detached; leaves green, awl-shaped, 12 mm. long or less, acute; spines usually solitary at young areoles, very slender, white, at areoles of old branches 2 or 3 together, 2 to 5 cm. long or less; sheaths of spines closely fitting or loose and papery, yellowish brown to whitish; areoles with very short white wool; flowers greenish or yellowish, 1.5 to 2 cm. long including the ovary; sepals broadly ovate, acute, or cuspidate; ovary obconic, bearing numerous small woolly brown areoles subtended by small leaves, its glochids brown; fruit small, globular to obovate or even clavate, often proliferous, red or rarely yellow, 10 to 18 mm. long, turgid, slightly fleshy; seeds compressed, 3 to 4 mm. broad, with narrow, often acute, margins.

Type locality: In Mexico.

Distribution: Southwestern United States and Mexico.

This species has a wide distribution for an *Opuntia*, extending from southern United States to Puebla, Mexico.

The great variation in the length of the spines and in the character of the spine sheaths has led to the description of several varieties. These all seem to us to merge into the one species, as above indicated. It sometimes hybridizes with *O. imbricata*. See C. B. Allaire's plant from San Antonio, New Mexico.

The following names, *Opuntia leptocaulis laetevirens* Salm-Dyck (Hort. Dyck. 184. 1834), *O. gracilis subpatens* Salm-Dyck (Cact. Hort. Dyck. 1849. 73. 1850), and *O. leptocaulis major* Toumey (Cycl. Amer. Hort. Bailey 3 : 1152. 1901) are printed but not described.

Illustrations: Bull. Torr. Club 32 : pl. 10, f. 9; Rep. Mo. Bot. Gard. 19 : pl. 21, in part; Safford, Ann. Rep. Smiths. Inst. 1908 : f. 12; Emory, Mil. Reconn. app. 2. f. 12; Pac. R. Rep. 4 : pl. 20, f. 1; pl. 24, f. 13 to 15, all as *Opuntia vaginata*. Cact. Journ. 1 : 154, as *Opuntia*

Fig. 56.—Opuntia leptocaulis in the foreground.

Fig. 57—Opuntia leptocaulis. ×0.4.

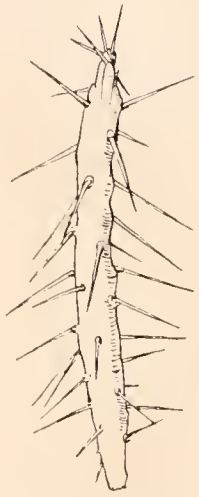


Fig. 58.—Opuntia caribaea. ×0.66.

frutescens. Pac. R. Rep. 4 : pl. 20, f. 4, 5; pl. 24, f. 19, all as *Opuntia frutescens brevispina*. Pac. R. Rep. 4 : pl. 20, f. 2, 3; pl. 24, f. 16 to 18, all as *Opuntia frutescens longispina*.

Plate VI, figure 3, represents a fruiting branch from a plant collected by Dr. Rose near Sierra Blanca, Texas, in 1913; figure 4 shows a fruiting branch from another Texas plant obtained by the same collector. Figure 56 is from a photograph taken by Dr. MacDougal near Tucson, Arizona, in 1913; figure 57 represents a branch with young leafy shoots, of a specimen collected by Dr. Rose in 1913 at Laredo, Texas.

4. **Opuntia tesajo** Engelmann in Coulter, Contr. U. S. Nat. Herb. 3 : 448. 1896.

Bushy, 3 dm. broad and high; joints slender, indistinctly tuberculate, 2 to 5 cm. long; areoles 5 to 6 mm. apart; leaves awl-shaped, 2 to 4 mm. long, often red; spines at first 2, small, dark brown, 4 to 8 mm. long, either erect or reflexed; later a long central spine develops, this porrect, 5 cm. long, yellow near the tip; flowers yellow, small, 1.5 to 1.8 cm. long, including the ovary; style whitish; stigma-lobes 5, yellowish.

Type locality: In Lower California.

Distribution: Central part of Lower California.

The type of this little-known species should be in the herbarium of the Missouri Botanical Garden, at St. Louis, but it can not now be found. The species has been in cultivation at La Mortola, Italy, but it does not do well under cultivation. Dr. C. A. Purpus, who has collected the plant in Lower California, regarded it as related to *O. ramosissima*, claiming that the stems have the peculiar marking of that species. This

M. E. Eaton del.

1, 2. Branches of *Opuntia mortolensis*.
3, 4. Branches of *Opuntia leptocaulis*.
5. Flowering branch of *Opuntia arbuscula*.
6. Flowering branch of *Opuntia kleiniae*.

(All natural size.)

relationship, however, is not shown in the La Mortola plant. With only a very meager description published and no type specimen preserved, it is difficult to decide the relationship of this species. No exact type locality is cited for it, but it is said to grow "among rocks, especially towards the west coast, and in the more central portions" of Lower California, where it was first collected by W. M. Gabb in 1867.

We refer this species with hesitation to the series *Leptocaules*.

Opuntia tenajo (Just's Bot. Jahresb. 24^2: 380. 1896) is doubtless an error in spelling for *O. tesajo*.

FIG. 59.—Opuntia caribaea forming dense thickets.

5. **Opuntia caribaea** sp. nov.

Stems 1 to 3 meters high, forming thickets in open woods and waste grounds; ultimate joints horizontal, 5 to 10 cm. long, much thicker than in *O. leptocaulis*, with short, elevated tubercles; areoles large, bearing white wool and a few long caducous hairs; spines 1 to 3, porrect, acicular, 2 to 3 cm. long, covered with thin, brown, papery sheaths; glochids dark brown; leaves small, 1 to 2 mm. long, acute; flowers not known; fruit red, 1.5 to 2 cm. long, usually naked but sometimes bearing short spines from the upper areoles, so far as known always sterile.

Very common on the cactus plain about Azua and also near Barahona, Santo Domingo; collected near Azua, March 1913, by Rose, Fitch, and Russell (No. 3837, type); also by Paul Bartsch in Haiti, 1917; also on the northern coast of Venezuela, and on Margarita Island, and apparently in Trinidad, as indicated by a colored drawing in the Kew herbarium received in 1825 from David Lockhart.

The plant grows in great abundance in Santo Domingo with other cacti, and certainly appears to be indigenous. Its nearest relative is *O. leptocaulis*, from which it differs in its greater size, thicker joints, and larger fruit.

Figure 58 represents a joint of a plant collected by Rose, Fitch, and Russell at Azua, Santo Domingo, in 1913; figure 59 is from a photograph of the type plant taken by Paul G. Russell.

6. Opuntia arbuscula Engelmann, Proc. Amer. Acad. 3: 309. 1856.

Opuntia neoarbuscula Griffiths, Rep. Mo. Bot. Gard. 19: 260. 1908.

Forming a bush 2 to 3 meters high, often with a rounded, very compact top with numerous short branches; trunk short, 10 to 12 cm. in diameter, with several woody branches; ultimate joints 5 to 7.5 cm. long, 8 mm. in diameter, with low, indistinct tubercles; leaves small; spines usually 1, but sometimes several, especially on old joints, porrect, up to 4 cm. long, covered with loose straw-colored sheaths; flowers greenish yellow tinged with red, 3.5 cm. long; fruit often proliferous, sometimes only one-seeded.

FIG. 60.—Opuntia arbuscula.

Type locality: On the lower Gila near Maricopa village.

Distribution: Arizona and Sonora.

Opuntia congesta Griffiths (Rep. Mo. Bot. Gard. 20: 88, pl. 2, f. 4, 7; pl. 8; pl. 13, f. 5. 1909), from the description, is near this species and probably a race of it.

Races of the species differ in size, in armament, in the length of the tubercles, and in size and shape of the fruit.

Illustrations: Ariz. Agr. Exp. Sta. Bull. 67: pl. 6, f. 2; Bull. Torr. Club 32: pl. 9, f. 3; Plant World 11^{10}: f. 11; Rep. Mo. Bot. Gard. 19: pl. 22; 19: pl. 23, in part, this last as *Opuntia neoarbuscula;* Carnegie Inst. Wash. 269: pl. 11, f. 95.

Plate VI, figure 5, represents a flowering branch from Professor J. W. Toumey's collection at Tucson, Arizona. Figure 60 is from a photograph taken by Dr. MacDougal near Tucson, Arizona, in 1906; figure 61 is from a photograph taken by George B. Sudworth in Santa Rita Mountains, Arizona; figure 62 shows a fruiting branch from the same collection.

M. E. Eaton del. 1, 3, 4
Krieger del. 2, 5

1. Leafy branch of *Opuntia kleiniae*.
2. Terminal branch of *Opuntia vivipara*.
3. Branch of *Opuntia parryi*.
4. Flowering branch of *Opuntia echinocarpa*.
5. Fruiting branch of *Opuntia versicolor*.

(All natural size.)

7. Opuntia kleiniae De Candolle, Mém. Mus. Hist. Nat. Paris **17**: 118. 1828.

Opuntia wrightii Engelmann, Proc. Amer. Acad. **3**: 308. 1856.
Opuntia caerulescens Griffiths, Rep. Mo. Bot. Gard. **20**: 86. 1909.

Stems pale, glaucous, sometimes 2.5 meters tall, woody at base; tubercles long; areoles large, a little longer than wide, filled with white wool from the very first; spines usually 1, but sometimes more, from the base of the areole, covered with yellow sheaths, on old joints accompanied by several bristle-like spines from the lower margin of the areole; glochids yellow to brown; leaves linear, 15 cm. long, acute; flowers 3 cm. long, purplish; petals broad, rounded at apex; fruit red, 2 to 2.5 cm. long, long persisting; seeds 4 to 5 mm. broad.

FIG. 61.—Opuntia arbuscula.

FIG. 62.—Opuntia arbuscula. ×0.75.

Type locality: In Mexico.

Distribution: Texas to central Mexico.

Opuntia kleiniae was originally described as without tubercles on the stems, which has raised the question whether the plant bearing this name is properly referred; in this respect *O. arbuscula* answers the description better, but it is very doubtful whether *O. arbuscula* could have been known at that time.

Opuntia kleiniae has long been in cultivation and is to be seen in most collections.

In 1910 Dr. Rose collected near Alamos, Mexico, an *Opuntia* very similar in habit and joints to *O. kleiniae*, but much more spiny.

Opuntia kleiniae cristata (Cat. Darrah Succ. Manchester 55. 1908) is a garden form. *O. kleiniae laetevirens* Salm-Dyck (Cact. Hort. Dyck. 1849. 73. 1850) is only a name.

Illustrations: Abh. Bayer. Akad. Wiss. München **2**: pl. 1, sec. 7, f. 9; Rep. Mo. Bot. Gard. **19**: pl. 21, in part; **20**: pl. 6, in part, this last as *Opuntia caerulescens*.

Plate VI, figure 6, represents a flowering branch of a specimen obtained from M. Simon, of St. Ouen, Paris, France, in 1901; plate VII, figure 1, represents a leafy branch of a specimen collected by Dr. Rose at Ixmiquilpan, Mexico, in 1905.

Two remarkable opuntias were collected in Lower California by Dr. Rose in 1911, but as they were not in flower or fruit, and have not developed flowers since they were brought into cultivation, we are unable to describe them fully; they are doubtless of this relationship and their characters are given as follows:

OPUNTIA sp.

Stems 1.3 to 2 meters high, rather weak, often clambering over bushes, 10 mm. in diameter, woody below, pale, when dry the white epidermis peeling off; lateral branches numerous, horizontal,

short (2 to 6 cm. long); areoles on old stems bearing 3 or 4 long (2 to 4 cm. long) needle-like brownish spines; young areoles usually with a single spine each, filled with brown wool; glochids brown, numerous sheaths on young spines straw-colored, soon deciduous; flowers and fruit unknown.

Description based on field notes and on living and herbarium specimens.

Collected by Dr. Rose on Santa Cruz Island, Gulf of California, April 1, 1911 (No. 16845).

OPUNTIA sp.

Procumbent, forming an indeterminable mass of spiny branches, 3 to 10 dm. in diameter; old stems woody, smooth, brown, and shiny, 2 cm. in diameter; branches 10 to 20 cm. long, bluish green; spines of two kinds; the 2 to 4 principal ones long (2 to 3 cm. long), needle-like, at first covered with thin yellow sheaths, straw-colored when young, becoming purplish, finally fading to gray; secondary spines 4 to 6, radial, inconspicuous; glochids brownish; flowers and fruit unknown.

Description based on field notes and living and herbarium specimens.

Collected by Dr. J. N. Rose on East San Benito Island, off the coast of Lower California, March 9, 1911 (No. 16085). This is, doubtless, the plant referred to by Walton (Cact. Journ. 2: 137. 1899) as *O. ramosissima*, but it is not that species.

Series 3. THURBERIANAE.

Bushy, arborescent, or depressed species, with slender joints, the ultimate ones tuberculate, about 2 cm. thick or less, the areoles bearing several spines. We recognize 8 species, 7 of them natives of the southwestern United States and northern Mexico, and 1 in Lower California.

KEY TO SPECIES.

Bushy or arborescent species, 6 dm. high or higher.
- Tubercles narrowly oblong, 1 cm. long or more.
  - Joints readily detached ..... 8. *O. vivipara*
  - Joints not readily detached.
    - Longer spines 2.5 cm. long or longer.
      - Flowers orange to scarlet ..... 9. *O. tetracantha*
      - Flowers purple ..... 10. *O. recondita*
    - Spines 2 cm. long or less ..... 11. *O. thurberi*
- Tubercles low, oblong, 6 to 8 mm. long ..... 12. *O. clavellina*

Depressed species, 6 dm. high or less.
- Spines yellow or brown; flowers green or tinged with yellow.
  - Spines yellow, up to 5 cm. long; petals 1 to 1.5 cm. long ..... 13. *O. davisii*
  - Spines brown, 2.5 cm. long or less; petals 2 to 2.5 cm. long ..... 14. *O. viridiflora*
- Spines white; flowers yellow ..... 15. *O. whipplei*

8. Opuntia vivipara Rose, Smiths. Misc. Coll. **52**: 153. 1908.

Plant 2 to 3.5 meters high, usually several strong branches from the base, 8 to 10 cm. in diameter, much branched above, but not compactly so; old stems with rather smooth bark; young branches bluish green, slender, 1 to 2 cm. long, 10 to 12 mm. in diameter; tubercles low, oblong, 15 to 20 mm. long; areoles when young bearing a dense cushion of yellow wool with few or no glochids; spines 1 to 4, 2 cm. long or less, porrect or ascending, covered with straw-colored sheaths; leaves small, terete, acutish, purple; flowers numerous, borne in clusters at the top of the branches, purplish; ovary strongly tuberculate, bearing white deciduous bristles; fruit oblong, 4 to 6 cm. long, smooth, with a somewhat depressed umbilicus, yellowish green, spineless; seeds white, very thick, 5 mm. long.

Type locality: Near Tucson, Arizona.

Distribution: Known only from type locality.

The relationship of this species is doubtful; it resembles certain garden forms of *O. tetracantha*, but differs from typical forms of that species in its much larger fruit and seeds, different armament, and habit. The type grew associated with *O. spinosior* and *O. versicolor*, but there is no indication that it is the result of hybridization of those species.

Illustrations: Smiths. Misc. Coll. 52: pl. 12; Plant World 11^{10}: f. 12.

Plate VII, figure 2, represents a branch drawn by L. C. C. Krieger at the Desert Botanical Laboratory, Tucson, Arizona; plate VIII, figure 1, is from a photograph of the type plant taken by Dr. MacDougal in 1908.

1

2

1. Type plant of *Opuntia vivipara*, near Tucson, Arizona.
2. A much-branched plant of *Opuntia versicolor*.

9. **Opuntia tetracantha** Toumey, Gard. and For. 9: 432. 1896.

Low bush, 5 to 15 dm. high, branching; central stem woody, 5 to 8 cm. in diameter; young joints 23 to 30 cm. long, 10 to 15 mm. in diameter, purplish; tubercles at first prominent, elongated, 16 to 22 mm. long; areoles bearing wool, light brown glochids, prominent glands and spines; spines 3 to 6, usually 4, slender, somewhat deflexed, 2 to 3.5 cm. long; flowers greenish purple, 1.5 to 2 cm. broad; fruit 2 to 2.5 cm. ong, yellowish orange to "scarlet," nearly smooth, but rarely bearing a few spines, deeply umbilicate; seeds 3 to 5 cm. broad, with irregular faces and a thick, spongy commissure.

Type locality: Five miles east of Tucson, Arizona.

Distribution: Known only from the region about Tucson, Arizona.

The species was originally compared by Mr. Toumey with *O. thurberi*, with which he thought it to be closely associated, but differing in "its longer, more strongly deflexed spines, smaller and different-colored flowers."

The type specimen was not indicated, but Toumey's own plant, collected in 1895, which was recently purchased by the U. S. National Herbarium, is doubtless the type.

Illustration: Bull. Torr. Club 32: pl. 9, f. 2.

Plate IX, figure 1, shows a joint painted by L. C. C. Krieger at the Desert Botanical Laboratory, Tucson, Arizona.

10. **Opuntia recondita** Griffiths, Monatsschr. Kakteenk. 23: 131. 1913.

"A stout broad-branched shrub, 1 to 1.5 meters in height; trunk cylindric, 4 to 7 cm. in diameter, with constrictions corresponding to each year's growth, with gray bark, and having a few lateral, easily detachable, weakly spined joints about 10 cm. long, the remaining joints being 20 to 30 cm. long, very spiny, in the second year about 2 cm. in diameter, tuberculate; tubercles forming a ridge, flattening out below, above extending precipitously, about 2 to 5 cm. long, 5 to 6 mm. wide, and 4 to 5 mm. high, remaining recognizable three years, and then disappearing; areoles broadly obovate, 5 to 6 mm. in the longest diameter, in age becoming larger and more prominent, forming new wool for several years; glochids yellow, in a thick 3 mm. long cluster on the upper part of the areole, also smaller clusters on the other parts of the areole, mostly at the base of the longest and most central spine; spines first 2 to 4, later 6 to 8 or 10, upr ght, spreading, 2.5 to 5 cm. long, in cross-section weakly circular, gray at the base, becoming deep reddish brown at the tips, surrounded the entire length by a loose, comparatively bright sheath; between the spines are scattered a few dirty-black, sheathless bristles about 6 mm. long; leaves subulate, finely tipped, terete, 12 to 20 mm. long.

"Flowers bright purple, when open about 2.5 cm. in diameter; petals finely and irregularly serrate, inconspicuously but finely irregularly notched; sepals thick, triangular pointed, greenish purple; anthers greenish with purple tinge; pistil greenish at base, with purple tinge above; stigma-lobes 6, white; ovary obovoid, tuberculate, with small areoles, 2 mm. in diameter, short greenish brown glochids 1 to 2 mm. long, and 1, 2, or 3 brown, caducous spines sheathed in part; fruit not deciduous, 3 to 3.5 by 2 to 2.4 cm., large, greenish yellow with a reddish tinge on the outermost side, only weakly tuberculate in the second year, with projecting brownish glochids 3 mm. long; seeds white, thick, mostly flat but often lightly angled with narrowly thickened edges, and often somewhat concave."

FIG. 63.—Opuntia thurberi. Natural size.

Type locality: La Perla, Mexico.

Distribution: Known only from type locality, and, to us, only from the description of which the above is a translation by Mr. Russell.

11. **Opuntia thurberi** Engelmann, Proc. Amer. Acad. 3: 308. 1856.

Large bushy plants, 2 to 4 meters high; joints slender, elongated, 1.5 to 2.5 dm. long, 10 to 12 cm. in diameter; tubercles 1.5 to 2 cm. long, flattened laterally; leaves linear, 6 to 8 mm. long, spread-

ing; spines 3 to 5, short (10 to 12 mm. long), spreading, covered with thin, brown, papery sheaths, the lowest one stoutest; flowers 3.5 cm. broad, brownish; fruit 2 cm. to 3 cm. long, spineless; seeds nearly globular, 4 mm. in diameter.

Type locality: Bacuachi, Sonora, Mexico.

Distribution: Western coast of Mexico.

Opuntia thurberi has long been one of our least-known species. The type, which is but a fragment, has not been clearly associated with any recent collections, but we are disposed now to believe that specimens collected on the west coast of Mexico by Dr. Rose in 1910 belong here. If we are correct, it ranges from Sonora to Sinaloa, Mexico. It is sometimes associated with *Opuntia versicolor* in its northern range, but is not so stout and has fewer and longer spines.

Figure 63 is from a photograph of the type specimen.

12. **Opuntia clavellina** Engelmann in Coulter, Contr. U. S. Nat. Herb. 3: 444. 1896.

Plant 1 meter high or less, rather openly branched; ultimate joints slender, spreading or ascending, somewhat clavate, 5 to 10 cm. long, a little over 1 cm. in diameter; tubercles prominent, elongated; spines 3 to 6 in a cluster, very long, covered with loose straw-colored or brown sheaths, the central one much longer and porrect; flowers yellow; fruit clavate, short, tuberculate.

Type locality: Near Misión Purísima, Lower California.

Distribution: Interior of central Lower California.

The above description is based on the original one and on the type If the plant illustrated as cited below belongs here, this is a very distinct species, which was referred, however, by Mrs. Brandegee to *Opuntia molesta* Brandegee.

Illustration: Contr. U. S. Nat. Herb. 16: pl. 129, A.

Of this series there is another peculiar Lower California species, perhaps nearest *O. clavellina*, but of different habit and spines. It also suggests *O. tetracantha* of Arizona. It was obtained first by Dr. Rose in 1911, but was without flowers or fruit. It may be characterized as follows:

OPUNTIA sp.

Stems slender (1 to 1.5 cm. in diameter), weak, often clambering over bushes, pale green in color, terete, pointed, 6 to 7 dm. long; areoles set on low tubercles, circular; chief spines 2 to 6, only slightly spreading, nearly equal, 1.5 to 2.5 cm. long, clothed with loose straw-colored sheaths (rose-colored when very young); accessory spines 3 or 4, almost bristle-like, borne from the lower parts of the areoles; glochids short, greenish when young, yellow in age; flowers and fruit not seen.

Collected by Dr. J. N. Rose on Cerralvo Island, off southern Lower California, April 19, 1911 (No. 16875), and also by Nelson and Goldman on the same island in 1906 (No. 7524).

13. **Opuntia davisii** Engelmann and Bigelow, Proc. Amer. Acad. 3: 305. 1856.

Plants low, 3 to 5 dm. high, much branched, their dense covering of straw-colored spines making them conspicuous objects in the landscape; terminal joints slender, 6 to 8 cm. long, about 1 cm. in diameter, strongly tuberculate; spines 6 to 12, unequal, the longest ones 4 to 5 cm. long, acicular, covered with thin sheaths; glochids numerous, yellow; flowers, including ovary, 3.5 cm. long; petals olive-green to yellow, broad, with rounded mucronate tips; ovary with large areoles bearing a few spines each; fruit 3 cm. long, somewhat tuberculate, naked; seeds not known.

Type locality: Upper Canadian, about Tucumcari Hills, near the Llano Estacado.

Distribution: Western Texas and eastern New Mexico.

For many years this plant was not collected and the name was confused with other species, so that at one time it was supposed to extend as far west as California. It is now believed to have a rather circumscribed range. It is first seen going west on the Texas & Pacific Railroad about Colorado, Texas.

The plant was named for Jefferson Davis, who was Secretary of War when Whipple's report was made.

Krieger del. 1, 6
Kako Morita del. 2 to 5

1. Joint of *Opuntia tetracantha*. 2 to 5. Flowering joints of *Opuntia versicolor*.
6. Proliferous fruits of *Opuntia fulgida*. (All natural size.)

Illustrations: Curtis's Bot. Mag. 108: pl. 6652; Pac. R. Rep. 4: pl. 16.
Figure 64 is copied from the second illustration above cited.

14. Opuntia viridiflora sp. nov.

A low, round, bushy plant 30 to 60 cm. high; terminal joints 5 to 7 cm. long, 1.5 to 2 cm. thick, often quite fragile; areoles prominent, flattened from the sides; areoles circular, filled with short, yellow or dull-gray wool; spines 5 to 7, somewhat spreading, the longest ones 2 cm. long, dark brown in color; glochids numerous, very short, yellow; flowers at tips of branches in clusters of 3 to 8, 3.5 to 4.5 cm. long (including ovary), "green, tinged with red"; fruit strongly tuberculate, except for a few long, deciduous bristles, with a deep umbilicus; seeds smooth, white, 3 mm. broad.

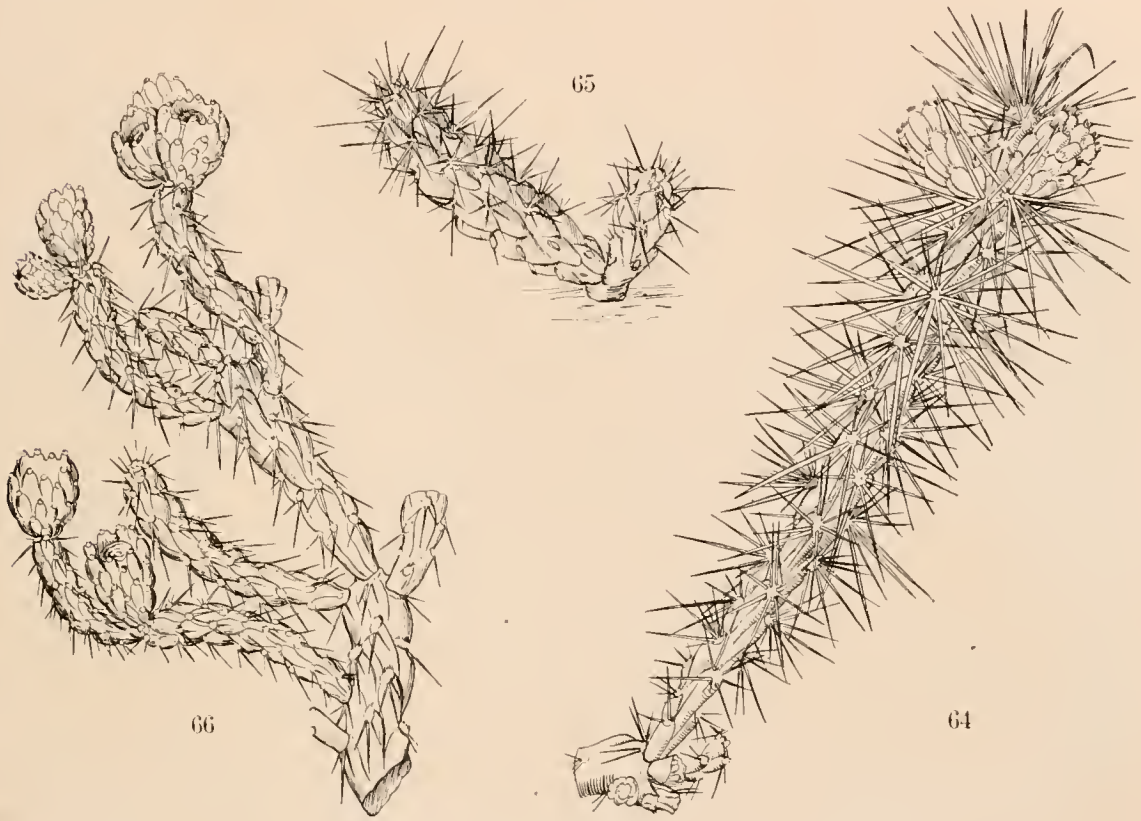


FIG. 64.—Opuntia davisii. ×0.5 FIG. 65.—Opuntia viridiflora. ×0.5. FIG. 66.—Opuntia whipplei. ×0.5

Collected in the vicinity of Santa Fé, New Mexico, altitude about 2,225 meters, by Paul C. Standley, July 6, 1911 (No. 6493, type) and at the same locality by T. D. A. Cockerell in 1912, and by J. N. Rose in 1913 (No. 18776). It is quite common on the hills just north of Santa Fé about Fort Marcy, where it is one of the dominant plants, but it was not observed elsewhere in that region.

This species differs from *Opuntia imbricata* with which it is found, in its much lower stature, more bushy habit, in its branches, spines, and smaller, differently colored flowers, different fruit, and smaller seeds.

Figure 65 represents two joints of a specimen collected by Dr. Rose at the type locality in 1913.

15. Opuntia whipplei Engelmann and Bigelow, Proc. Amer. Acad. 3: 307. 1856.

Opuntia whipplei laevior Engelmann, Proc. Amer. Acad. 3: 307. 1856.

Low, much branched, with long, fibrous roots; areoles prominent, flattened laterally, 10 to 15 cm. long, circular, filled with light-brown wool; glochids pale yellow, short; spines about 12, the

longest about 2 cm. long, dark brown, covered with lighter colored papery sheaths; flowers yellow, small (2 cm. broad); young ovary bearing brown spines in the axils of the leaves; fruit strongly tuberculate, spineless, 2.5 to 4 cm. long, with a deeply depressed umbilicus, sometimes with only one seed but usually many; seeds small, 4 cm. broad, smooth.

Type locality: About Zuni, New Mexico.

Distribution: Northern New Mexico and Arizona to southwestern Colorado and probably southern Utah. Also reported by Coulter in southern California, Lower California, and Sonora, but not to be expected there.

Illustration: Pac. R. Rep. 4: pl. 24, f. 9, 10.

Figure 66 is copied from the illustration above cited.

FIG. 67.—Opuntia acanthocarpa in the foreground. Photograph by MacDougal.

Series 4. ECHINOCARPAE.

Dry-fruited, rather stout-jointed, bushy or depressed species, the areoles bearing several spines, the flowers red, yellow, or yellowish. Four species, inhabiting the southwestern United States, Sonora, and Lower Californja.

KEY TO SPECIES.

Tubercles elongated, 2 to 3 times as long as wide.
- Fruit long-spiny, strongly tuberculate ..... 16. *O. acanthocarpa*
- Fruit short-spiny, little tuberculate ..... 17. *O. parryi*

Tubercles short, less than twice as long as wide.
- Spines with white or straw-colored sheaths ..... 18. *O. echinocarpa*
- Spines with yellow-brown sheaths ..... 19. *O. serpentina*

16. Opuntia acanthocarpa Engelmann and Bigelow, Proc. Amer. Acad. 3: 308. 1856.

Much branched, 1.5 to 2 meters high; branches becoming woody, alternate, making a narrow angle with the trunk; terminal joints 4 to 8 cm. long, strongly tuberculate; tubercles elongated, flattened laterally; spines 8 to 25, acicular, dark brown, covered with thin and lighter colored sheaths, 2 to 3 cm. long; glochids numerous, yellow; flowers large, red to yellow, 5 cm. long, and when fully open nearly as broad; ovary rather short, turbinate, with few prominent tubercles; fruit dry, about 3 cm. long, naked below, tuberculate above, each tubercle crowned by a cluster of 10 to 12 stout spines; umbilicus broad and somewhat depressed; seeds 5 to 6 cm. broad, sharply angular.

Type locality: On the mountains of Cactus Pass, Arizona, about 500 miles west of Santa Fé, New Mexico.

Distribution: Arizona and California; reported also from Utah, Nevada, and Sonora.

Illustrations: N. Amer. Fauna 7: pl. 7, 8; Pac. R. Rep. 4: pl. 18, f. 1 to 3; pl. 24, f. 11.

Figure 67 is from a photograph by Dr. MacDougal of a plant near Pictured Rocks, Tucson Mountains, Arizona.

17. Opuntia parryi Engelmann, Amer. Journ. Sci. II. 14: 339. 1852.

Opuntia bernardina Engelmann in Parish, Bull. Torr. Club 19: 92. 1892.

Low and bush-like, 2 to 4 dm. high; joints cylindric, 7 to 30 cm. long by 1.5 to 2 cm. in diameter, strongly tuberculate; tubercles 1 to 1.5 cm. long; areoles rather large, bearing light-brown wool, yellow glochids, and spines; spines about 10, dark brown, the longer ones 3 cm. long, covered with loose sheaths; flowers, several near together at ends of branches, 4 cm. long; sepals greenish or dull red; petals yellow, obtuse; stigma-lobes cream-colored; ovary tuberculate; fruit dry, ovoid, 2 cm. long, strongly umbilicate, when mature and fertile plump, otherwise more or less tuberculate; areoles on the fruit large, filled with wool and glochids, those at top of fruit often with short spines; seeds white, 4 to 6 mm. broad, beaked, the margins channeled.

Type locality: Near San Felipe, eastern slope of California Mountains—San Jacinto Mountains.

Distribution: Interior valleys of southern California.

This is common in some of the interior valleys of southern California, although its range has not been very definitely determined. It was first collected by Dr. C. C. Parry in 1851 and named for him by Dr. Engelmann in 1852; but when the latter again took up this name a few years later, he associated it with a very different species, which most later writers and dealers accepted as the true *Opuntia parryi*. Later on Dr. Engelmann segregated a species which he named *O. bernardina*, including therein Parry's specimen, but this was not published until after his death. We therefore regard *O. bernardina* as a synonym of *O. parryi*, while the *O. parryi* of most collections becomes *O. parishii*. We are under obligation to Mr. C. R. Orcutt for first calling our attention to this confusion.

Mr. Orcutt thinks that this species is near *O. serpentina;* but the former has larger flowers, different spines, much less spiny fruit, and is of different habit.

Opuntia bernardina cristata Schumann (Monatsschr. Kakteenk. 12: 20. 1902), an abnormal form, has been described.

Plate VII, figure 3, is from a plant collected by W. T. Schaller at Pala, California, showing a leafy joint.

18. Opuntia echinocarpa Engelmann and Bigelow, Proc. Amer. Acad. 3: 305. 1856.

Opuntia echinocarpa major Engelmann, Proc. Amer. Acad. 3: 305. 1856.
Opuntia echinocarpa nuda Coulter, Contr. U. S. Nat. Herb. 3: 446. 1896.
Opuntia echinocarpa parkeri Coulter, Contr. U. S. Nat. Herb. 3: 446. 1896.
Opuntia echinocarpa robustior Coulter, Contr. U. S. Nat. Herb. 3: 446. 1896.
Opuntia deserta Griffiths, Monatsschr. Kakteenk. 23: 132. 1913.

Plant usually low, but sometimes 1.5 meters high, much branched and widely spreading, with a short woody trunk 2 to 3 cm. in diameter, in age with nearly smooth bark; joints short, turgid, strongly tuberculate; spines numerous, when young bright yellow, when older brownish, or in age grayish, unequally covered with thin papery sheaths; flowers yellowish, but the sepals often tipped with red; ovary short, turbinate, densely spiny especially in the upper part; fruit dry, very spiny; seeds somewhat angular, 4 mm. broad.

Type locality: In the Colorado Valley near the mouth of Bill Williams River.

Distribution: Nevada, Utah, Arizona, California, and Lower California.

Coulter has described three varieties of this species, none of which is quite typical, but without seeing more specimens we can only refer them all to the species proper. His variety *parkeri* seems more like a very spiny form of *O. parryi*. *O. parkeri* Engelmann (Coulter, Contr. U. S. Nat. Herb. 3: 446. 1896) was published as a synonym.

Mrs. Brandegee thought *Opuntia echinocarpa nuda* very near *O. alcahes*, if not identical with it (Erythrea 5: 122).

Illustrations: Pac. R. Rep. 4: pl. 18, f. 5 to 10; pl. 24, f. 8; Monatsschr. Kakteenk. 23: 132, the last as *Opuntia deserta*.

Plate VII, figure 4, is from a plant collected by Dr. Rose near the Salton Sink, California, showing a flowering joint.

19. Opuntia serpentina Engelmann, Amer. Journ. Sci. II. 14: 338. 1852.

Cereus californicus Torrey and Gray, Fl. N. Amer. 1: 555. 1840. Not *Opuntia californica* Engelmann. 1848.
Opuntia californica Coville, Proc. Biol. Soc. Washington 13: 119. 1899.

Ascending, erect, or prostrate; branches slender, 2 to 2.5 cm. in diameter, bluish green, strongly tuberculate; leaves minute; tubercles elevated, 1 to 1.5 cm. long, longer than broad, flattened; spines 7 to 20, brown, covered with yellowish-brown papery sheaths about 1 cm. long; glochids light brown; flowers close together at the top of short branches, about 4 cm. broad, greenish yellow, the outer petals tinged with red; ovary strongly tuberculate, spiny, with a depressed umbilicus; fruit dry, very spiny.

Type locality: Near the seacoast about San Diego, California.

Distribution: Southern California and northern Lower California.

Cactus californicus Nuttall, although given in the Index Kewensis (1: 367), was never published by Nuttall, although he did have the name in manuscript, as stated in Torrey and Gray's "Flora" in the place cited above, where it was taken up as a *Cereus*.

Figure 68 is from a plant collected by Mr. G. Sykes near San Diego, California.

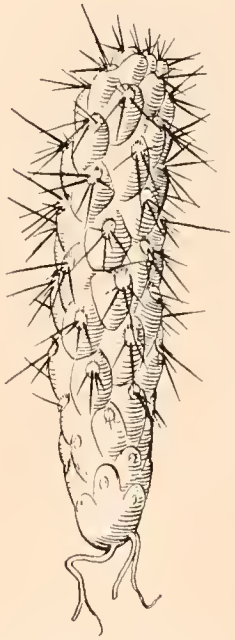


FIG. 68.—Opuntia serpentina. ×0.66

Series 5. BIGELOVIANAE.

We recognize two species in this series, natives of the southwestern United States and Lower California. They are low, bushy plants, with short definite trunks densely covered with short, stout, very spiny branches, the spines white, straw-colored, or yellow, the tubercles, at least those of young shoots, little if any longer than broad, and considerably elevated. Their fruits are fleshy berries.

KEY TO SPECIES.

Larger spines numerous; upper tubercles on fruit larger than lower ones 20. *O. bigelovii*
Larger spines 4 to 6; tubercles on fruit all alike ..... 21. *O. ciribe*

20. Opuntia bigelovii Engelmann, Proc. Amer. Acad. 3: 307. 1856.

Usually with a central, erect trunk, 1 meter high or less, with short lateral branches, the upper ones erect; joints usually 5 to 15 cm. long, very turgid, with closely set areoles and almost impenetrable armament; tubercles slightly elevated, pale green, somewhat 4-sided, about as long as broad, 1 cm. broad or less; spines, as well as their papery sheaths, pale yellow; flowers several, borne at the tips of the branches, 4 cm. long including the ovary; sepals orbicular, about 1 cm. in diameter, tinged with red; petals about 1.5 cm. long, pale magenta to crimson; ovary 2 cm. long, its large areoles bearing brown wool and several acicular spines; fruit usually naked, strongly tuberculate, the upper tubercles larger than the lower.

Type locality: Bill Williams River, Arizona.

Distribution: Southern Nevada, Arizona, California, northern Sonora, and northern Lower California.

Illustrations: Ann. Rep. Bur. Amer. Ethn. 26: pl 12; Contr. U. S. Nat. Herb. 16: pl. 128, B; Hornaday, Camp-fires on Desert and Lava, facing p. 154; Journ. N. Y. Bot. Gard. 5: f. 16; Pac. R. Rep. 4: pl. 19; Plant World 11^{10}: f. 10.

Figure 69 is from a photograph by Dr. MacDougal of a plant in Pima Canyon, Santa Catalina Mountains, Arizona; figure 70 is copied from the Pacific Railroad Report above cited.

21. **Opuntia ciribe** Engelmann in Coulter, Contr. U. S. Nat. Herb. 3: 445. 1896.

One meter high or less, with numerous stout branches densely armed; ultimate joints 4 to 5 cm. in diameter, strongly and regularly tuberculate, 3 cm. in diameter; tubercles about as long as broad

FIG. 69.—Opuntia bigelovii.

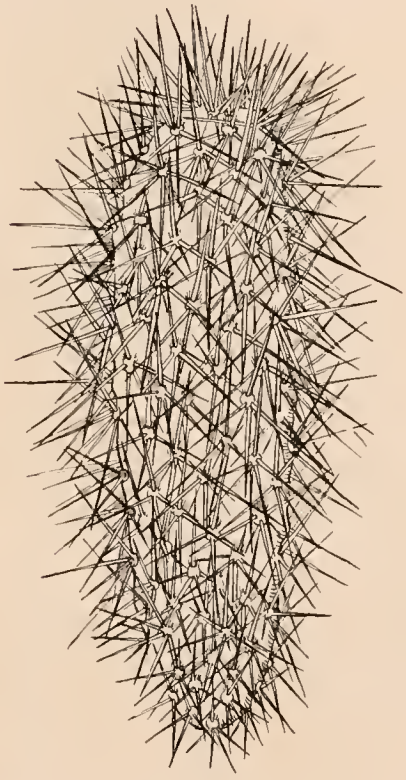


FIG. 70.—Opuntia bigelovii. ×0.66.

(5 to 7 cm. broad); larger spines 4 to 6, stout, 2 to 3 cm. long, covered with loose yellow sheaths, accompanied by several bristle-like spines or hairs; glochids numerous; flowers yellow; ovary somewhat bristly; fruit strongly tuberculate, 3 to 4 cm. long, spineless.

Type locality: Comondu and Loreto northward to beyond Rosario, Lower California.

Distribution: Central Lower California.

Opuntia ciribe is near *O. bigelovii*, but differs from it in having less spiny stems and globular, slightly different fruits.

Figure 71 is from a photograph of a plant collected by Dr. Rose at the head of Concepción Bay, Lower California; figure 72 is from a drawing of a joint from the same plant.

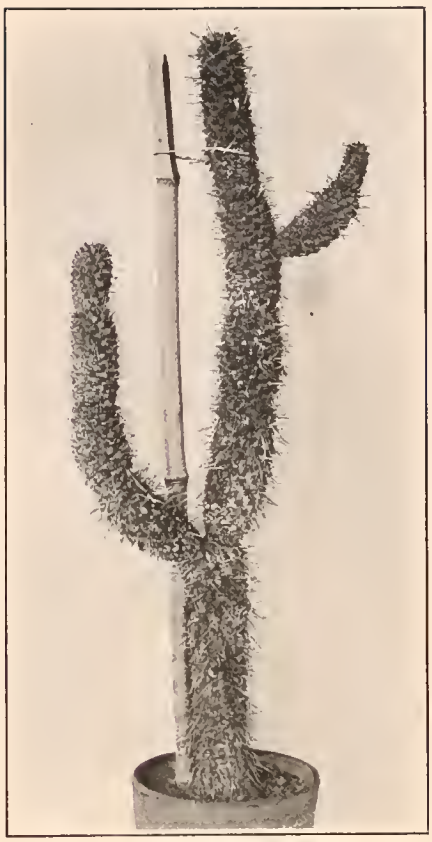


FIG. 71.—Opuntia ciribe.

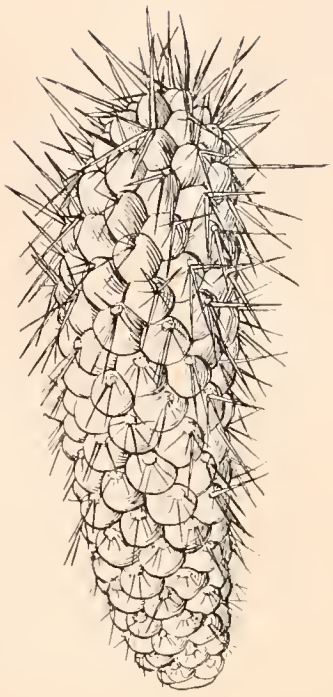


FIG. 72.—Opuntia ciribe. ×0.8.

Series 6. IMBRICATAE.

The typical species are tall, much branched, very spiny. The terminal joints are fleshy and strongly tuberculate, the tubercles large and flattened laterally. The fruit is either smooth or strongly tuberculate. We recognize 8 species, natives of Mexico and southwestern United States.

KEY TO SPECIES.

Joints cylindric; tubercles much flattened laterally.
- Fruit smooth or but slightly tuberculate.
  - Branches very stout, 5 cm. thick or more ..... 22. *O. cholla*
  - Branches relatively slender, 2 cm. thick or less.
    - Plant glaucous; spines 4 at an areole ..... 23. *O. calmalliana*
    - Plant not glaucous; spines more than 4 at an areole ..... 24. *O. versicolor*
- Fruit manifestly tuberculate.
  - Tall species, up to 2 or 4 meters high.
    - Flowers small; petals 1.5 cm. long ..... 25. *O. lloydii*
    - Flowers large; petals 2 to 3 cm. long ..... 26. *O. imbricata*
  - Low species, 6 dm. high or less.
    - Flowers yellow ..... 27. *O. tunicata*
    - Flowers rose-colored ..... 28. *O. pallida*

Joints clavate; tubercles not much flattened laterally ..... 29. *O. molesta*

22. Opuntia cholla Weber, Bull. Mus. Hist. Nat. Paris 1: 320. 1895.

Usually tree-like, 1 to 3 meters high, with a definite trunk 7 to 15 cm. in diameter; trunk very spiny at first and becoming more spiny each year for some time, but in age spineless and developing a smooth, brownish yellow bark; top of plant often dense and broad; joints often in whorls, horizontal, pale, with large compressed tubercles; spines usually numerous, more or less porrect, covered with loose brownish sheaths; glochids numerous, yellow; flowers rather small, 3 cm. broad, deep purple; fruit often 4 to 5 cm. long, usually proliferous, often in long chains of 8 to 12 individuals or forming compound clusters; seeds numerous, very small, often abortive.

Type locality: In Lower California.
Distribution: Lower California.

This is one of the commonest opuntias in southern Lower California and was usually seen by Dr. Rose at every locality visited south of Magdalena Bay on the west coast and on the east coast as far north as Muleje. It is undoubtedly the plant referred to *O. prolifera* by Mr. Brandegee, but it differs in habit and armament from that species; the fruit of *O. prolifera* is nearly or quite devoid of seeds, while this species often has numerous small ones. In this species, as in a few other opuntias, the fruits are quite proliferous, hanging on for a number of years and usually remaining green. They are, however, easily detached, and on falling to the ground, readily take root and start new colonies. Our illustration shows some of the fruits which have already rooted and have developed young joints.

The plant here described is the true "cholla" of the people of Lower California, and is the plant cultivated under that name by A. Berger at La Mortola from a cutting of Weber's type specimen, and by the late Mr. Darrah at Manchester, England.

Illustrations: Contr. U. S. Nat. Herb. 16: pl. 128, A; Karsten and Schenk, Vegetationsbilder 13: pl. 17, B.

Figure 73 is from a photograph of a plant collected by Dr. Rose at Cape San Lucas; figure 74 represents a joint of the same plant; figures 75 and 76 represent its proliferous fruits developing new joints.

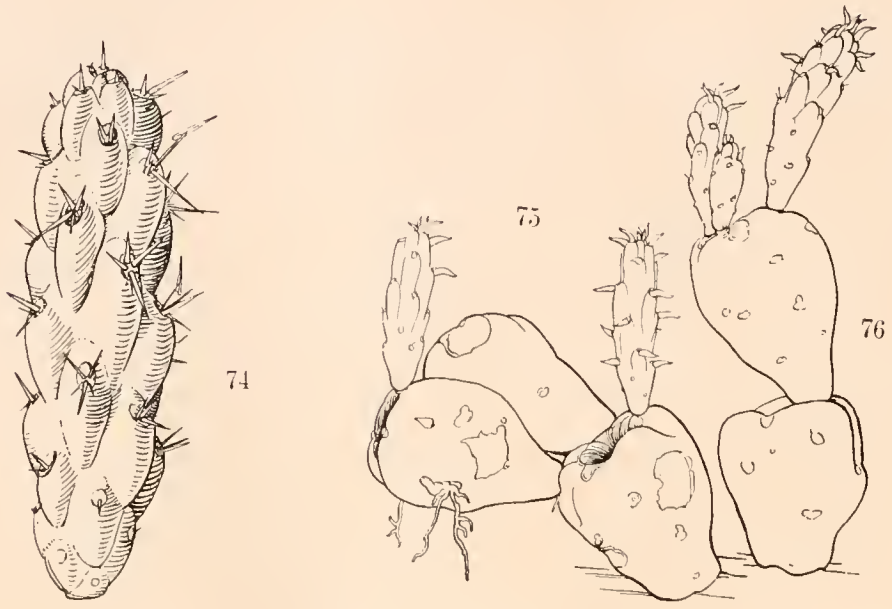
FIG. 73.—Opuntia cholla.

23. **Opuntia calmalliana** Coulter, Contr. U. S. Nat. Herb. 3: 453. 1896.

"Habit and height unknown; joints cylindrical, 1 to 2 cm. in diameter, glaucous, with linear-oblong crested (mostly distinct) tubercles 20 to 25 mm. long; pulvini densely covered with yellowish wool, and with a penicillate tuft of whitish bristles at upper edge; spines usually 4, the upper one stout and porrect, reddish with yellowish tip (as are all the spines), 2 to 2.5 cm. long (occasionally 1 to 2 short upper ones added), the usually 3 (sometimes 4) lower ones more slender and sharply deflexed, 1 to 1.5 cm. long (occasionally one of them longer); flowers apparently purple; ovary covered with very prominent woolly pulvini which are more or less bristly and spiny, but ripening into a smooth juicy obovate fruit; seeds discoid and beaked, irregularly angular, with broad commissure, about 4 mm. broad." (Coulter, *l. c.*)

Type locality: Calmalli, Lower California.
Distribution: Lower California.
Type in the Brandegee Herbarium, University of California.

Referred by Mrs. Brandegee (Erythea 5: 122) to *O. molesta* Brandegee. It is closely related to *O. molesta*, but its spines are different, though on the same general plan, and its seeds are quite different.



FIGS. 74, 75, 76.—Opuntia cholla. ×0.66.

24. **Opuntia versicolor** Engelmann in Coulter, Contr. U. S. Nat. Herb. 3: 452. 1896.

Opuntia arborescens versicolor E. Dams, Monatsschr. Kakteenk. 14: 3. 1904.

Bush or tree-like, 2 to 4 meters high, with a large, open top sometimes 5 meters broad; trunk and larger stems woody throughout, except the younger branches; terminal joints 10 to 20 cm. long, 2.5 cm. in diameter, variously colored, not strongly tuberculate when living; tubercles 1.5 cm. long; spines 5 to 11, 5 to 25 mm. long, dark colored, with close-fitting sheaths; glochids reddish brown; flowers variously colored, yellow, greenish, reddish, or brown, 3 to 5.5 cm. broad; ovary tuberculate, with large areoles bearing wool, glochids, and long deciduous bristles; fruit persisting for months, sometimes for a year, 2.5 to 4 cm. long, at first somewhat tuberculate, becoming pear-shaped or globose, sometimes proliferous; seeds white, 5 mm. broad.

Type locality: Tucson, Arizona.

Distribution: Arizona and northern Mexico.

This species is common on the lower foothills and is only rarely found on the mesas. It is of slow growth, propagating almost entirely from seed. As the name suggests, it has flowers of many colors; each plant has its own color and the color of the flowers is to a greater or less extent paralleled in that of the branches. The contrast in color shown by a colony of these plants is very striking and one's first impression is that more than one species exists.

Named specimens of this species were distributed by the late Dr. C. G. Pringle in 1881, but the species was not published until 1896.

Illustrations: Ariz. Agr. Exp. Sta. Bull. 67: pl. 6, f. 1; Bull. Torrey Club 32: pl. 9, f. 4 to 8; Hornaday, Camp-fires on Desert and Lava, pl. facing p. 18, 116, 320; N. Mex. Agr. Exp. Sta. Bull. 60: pl. 6, f. 1; Plant World 11^{10}: f. 8; Sargent, Man. Trees N. Amer. f. 561.

Plate VII, figure 5, represents a fruiting joint; plate VIII, figure 2, is from a photograph taken by Dr. MacDougal near the base of the Santa Catalina Mountains, Arizona; plate IX, figures 2 to 5, are paintings made at the Desert Laboratory, Tucson, Arizona, by Kako Morita, showing the range in color of the flowers.

25. Opuntia lloydii Rose, Contr. U. S. Nat. Herb. 12: 292. 1909.

Much branched, 2 to 3 meters high and nearly as broad; joints terete, 2 cm. in diameter; tubercles prominent, oblong; spines few, on last year's joints 3, reddish, 1.5 cm. long; leaves terete, 6 to 8 mm. long; flowers 3 cm. long, opening after midday; petals 15 mm. long, dull purple; filaments olive-green below purplish above; style rose-colored; stigma-lobes white; ovary yellowish, strongly tuberculate, naked; fruit 3 cm. long, yellow to orange, slightly tuberculate.

Type locality: On foot slopes, Hacienda de Cedros, Zacatecas, Mexico.

Distribution: Central Mexico.

According to F. E. Lloyd, for whom this species was named, it is known to the Mexicans as tasajo macho.

We have had this plant in cultivation for several years, but it does not grow well under glass; these specimens have white areoles; no glochids are developed the first

FIG. 77.—Opuntia lloydii.

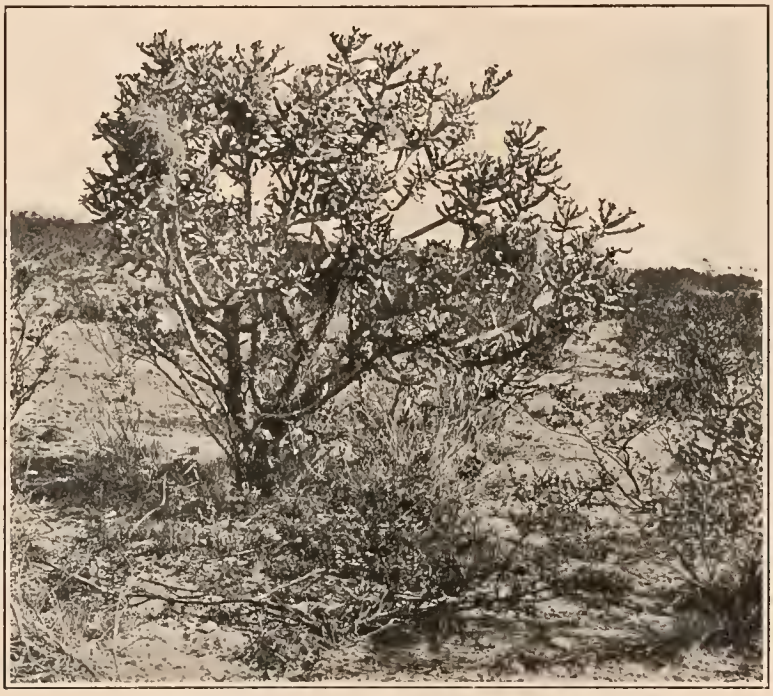


FIG. 78.—Opuntia lloydii. Photograph by F. E. Lloyd.

year, but on old branches dark-brown bunches of glochids are developed in the upper edges of the areoles, and the several brownish spines are acicular.

Illustration: Contr. U. S. Nat. Herb. 12: f. 34; pl. 25.

Figure 77 represents two joints of the type specimen; figure 78 is from a photograph of the type plant.

26. Opuntia imbricata (Haworth) De Candolle, Prodr. 3: 471. 1828.

Cereus imbricatus Haworth, Rev. Pl. Succ. 70. 1821.
Cactus cylindricus James, Cat. 182. 1825. Not Lamarck. 1783.
Cactus bleo Torrey, Ann. Lyc. N. Y. 2: 202. 1828. Not Humboldt, Bonpland, and Kunth. 1823.
Opuntia rosea De Candolle, Prodr. 3: 471. 1828.
Opuntia decipiens De Candolle, Mém. Mus. Hist. Nat. Paris 17: 118. 1828.
Opuntia exuviata De Candolle, Mém. Mus. Hist. Nat. Paris 17: 118. 1828.
Opuntia exuviata angustior De Candolle, Mém. Mus. Hist. Nat. Paris 17: 118. 1828.
Opuntia exuviata spinosior De Candolle, Mém. Mus. Hist. Nat. Paris 17: 118. 1828.
Opuntia exuviata stellata Lemaire, Cact. Gen. Nov. Sp. 67. 1839.
Opuntia exuviata viridior Salm-Dyck, Cact. Hort. Dyck. 1844. 48. 1845.
Opuntia arborescens Engelmann in Wislizenus, Mem. Tour North. Mex. 90. 1848.
Opuntia imbricata crassior Salm-Dyck, Cact. Hort. Dyck. 1849. 249. 1850.

Opuntia imbricata ramosior Salm-Dyck, Cact. Hort. Dyck. 1849. 73. 1850.
Opuntia imbricata tenuior Salm-Dyck, Cact. Hort. Dyck. 1849. 73. 1850.
Opuntia vexans Griffiths, Rep. Mo. Bot. Gard. **22**: 28. 1912.
Opuntia magna Griffiths, Proc. Biol. Soc. Washington **27**: 23. 1914.
Opuntia spinotecta Griffiths, Proc. Biol. Soc. Washington **27**: 24. 1914.

Tree-like, often 3 meters high or higher, with a more or less definite woody trunk 2.5 cm. in diameter; ultimate joints 2 to 3 cm. in diameter, strongly tuberculate; leaves 8 to 24 mm. long, terete; tubercles 2 to 2.5 cm. long, flattened laterally; spines 8 to 30, 2 to 3 cm. long, brown, covered with papery sheaths; flowers borne at ends of branches, 4 to 6 cm. long, sometimes 8 to 9 cm. broad, purple; ovary tuberculate, bearing a few bristles from some of the upper areoles; fruit naked, yellow, 2.5 to 3 cm. long, strongly tuberculate or, when long persistent, smooth; seeds 2.5 to 3.5 mm. in diameter.

Type locality: Unknown; introduced into England by Loddiges in 1820.

Distribution: Central Colorado to Texas, New Mexico, and central Mexico.

The plant is hardy in southwestern Kansas, and has been recorded as a native of that State; it has existed through three winters out of doors at the New York Botanical Garden, but has made little growth.

We have followed Schumann and Weber in uniting *Opuntia arborescens* and *O. imbricata*. As thus treated, the species has a wide geographic distribution, and in our view consists of many slightly differing races. In its northern limits it is much smaller than in its southern range.

Opuntia cristata tenuior Salm-Dyck (Cact. Hort. Dyck. 1844. 49. 1845, name only), *O. decipiens major* Hort. in Salm-Dyck (Cact. Hort. Dyck. 1844. 49. 1845, as synonym), *O. cristata* Salm-Dyck (Cact. Hort. Dyck. 50. 1842), and *O. stellata* Salm-Dyck (Cact. Hort. Dyck. 50. 1842) are unpublished names. *O. ruthei* is a garden name mentioned by Berger.

Opuntia exuviata major (Salm-Dyck, Cact. Hort. Dyck. 1844. 49. 1845) is an unpublished name.

Opuntia cardenche Griffiths (Rep. Mo. Bot. Gard. 19: 259. pl. 21, in part. 1908) is described as standing between *Opuntia kleiniae* and *O. imbricata*, being stouter than the

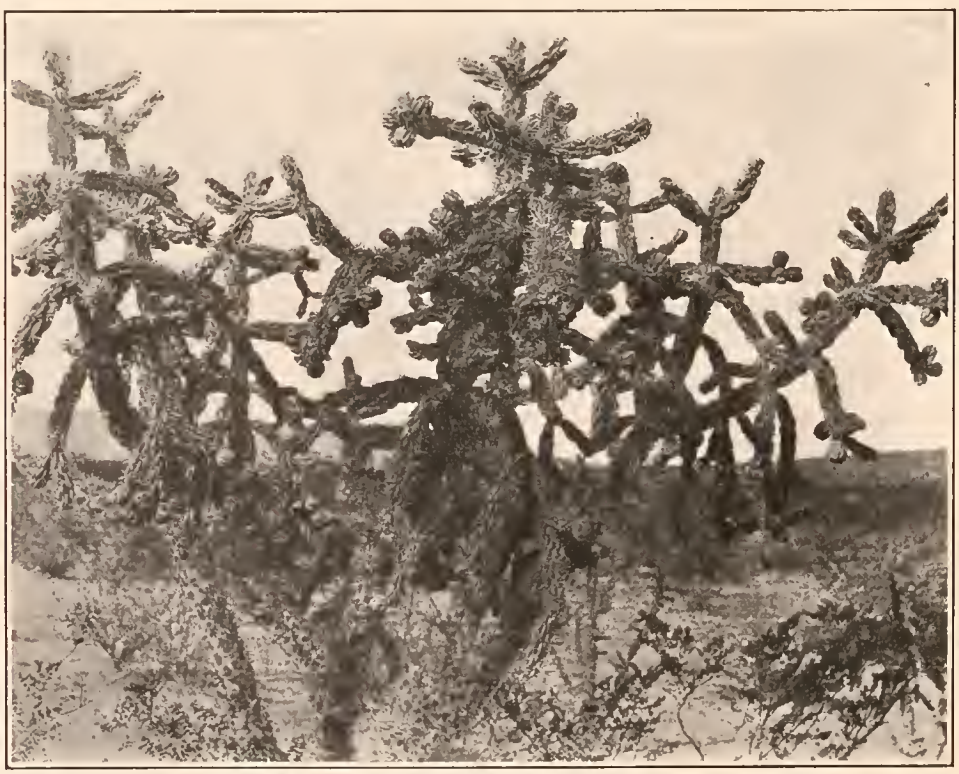


FIG. 79.—Opuntia imbricata.

one and more slender than the other. It resembles very closely specimens collected by Dr. Rose at Ixmiquilpan, Mexico, in 1905, which we have referred to *O. kleiniae*.

Opuntia galeottii de Smet (Miquel, Nederl. Krnidk. Arch. 4: 337. 1858) and *O. costigera* Miquel (Nederl. Kruidk. Arch. 4: 338. 1858), if really from Mexico, may belong here, but the descriptions are indefinite. Dr. Schumann did not know them.

Opuntia mendocienses (Cat. Darrah Succ. Manchester 56. 1908) is said to be "probably only a form of *O. imbricata*."

Opuntia undulata Link and Otto (Verh. Ver. Beförd. Gartenb. 6: 434. 1830) was not published. According to Pfeiffer, it is the same as *O. exuviata*, which we refer here.

Opuntia decipiens minor (Pfeiffer, Enum. Cact. 172. 1837) is unpublished.

Cactus subquadrifolius Mociño and Sessé (De Candolle, Prodr. 3: 471. 1828) was given as a synonym of *Opuntia rosea* and therefore belongs here.

FIG. 80.—Opuntia tunicata.

FIG. 81.—Opuntia pallida.

Illustrations: Agr. Gaz. N. S. W. 22: pl. opp. p. 696; Bull. U. S. Dept. Agr. 31: pl. 5; pl. 6, f. 1; Cact. Mex. Bound. pl. 73, f. 7, 8; Curtis's Bot. Mag. 135: pl. 8290; N. Mex. Agr. Exp. Sta. Bull. 60: pl. 7, f. 2; Förster, Handb. Cact. ed. 2. f. 134; Mém. Mus. Hist. Nat. Paris 17: pl. 15; W. Watson, Cact. Cult. f. 85, the last three as *Opuntia rosea*. W. Watson, Cact. Cult. f. 8, in part, this as *Opuntia decipiens*. Ann. Rep. Bur. Amer. Ethn. 26: pl. 8, f. *a*; Cact. Mex. Bound. pl. 75, f. 16, 17; Gard. Chron. III. 34: f. 36; Gard. and For. 9: f. 1; Illustr. Fl. 2: f. 2533; ed. 2. 2: f. 2992; N. Mex. Agr. Exp. Sta. Bull. 78: pl. [10]; Pac. R. Rep. 4: pl. 17, f. 5, 6; pl. 18, f. 4; pl. 24, f. 12; Rep. Mo. Bot. Gard. 22: pl. 7, in part; all as *Opuntia arborescens*. Rep. Mo. Bot. Gard. 22: pl. 6, 7, in part, these two as *Opuntia vexans*.

Plate XI, figure 1, represents a joint of a plant collected by W. L. Bray in western Texas. Figure 79 is from a photograph taken by Professor F. E. Lloyd in Zacatecas, Mexico, in 1908.

27. **Opuntia tunicata** (Lehmann) Link and Otto in Pfeiffer, Enum. Cact. 170. 1837.

Cactus tunicatus Lehmann, Ind. Sem. Hort. Hamb. 6. 1827.
Opuntia stapeliae De Candolle, Mém. Mus. Hist. Nat. Paris 17: 117. 1828.
Opuntia hystrix Grisebach, Cat. Pl. Cub. 117. 1866.
Opuntia perrita Griffiths, Rep. Mo. Bot. Gard. 22: 33. 1912.

Very variable, sometimes low and spreading from the base and forming broad clumps, at other times 5 to 6 dm. high, with a more or less definite woody stem and numerous lateral branches; joints easily detached, sometimes short and nearly globular to narrowly oblong, 10 to 15 cm. long, strongly tuberculate; spines reddish, normally 6 to 10, elongated, 4 to 5 cm. long, covered with thin, white, papery sheaths; flowers 3 cm. long, yellow; petals obtuse; ovary often bearing long spines at the areoles, but usually naked.

Type locality: In Mexico.

Distribution: Highlands of central Mexico; also in Ecuador, Peru, and northern Chile.

Opuntia stapeliae has long puzzled collectors and students of cacti. We are convinced now that it is only starved or stunted greenhouse specimens of the common *O. tunicata*. When grown in cultivation, *O. tunicata* takes on abnormal shapes, for the joints, which break off easily, rarely grow to their full size. In its native home many small dwarf plants are found everywhere about the larger plants. We have discussed this explanation of *O. stapeliae* with Mr. A. Berger, and he agrees with our conclusion.

No specimens of the type of *O. stapeliae* are preserved in the De Candolle Herbarium. The plant figured as *Opuntia stapeliæ* (?) by Goebel in Pflanzenbiologische (f. 36) does not belong here. It is erect, has strongly tuberculate joints, very short spines and narrow elongated leaves.

Cereus tunicatus (Pfeiffer, Enum. Cact. 170. 1837) is given as a synonym of *Opuntia tunicata*, but has never been formally taken up.

We believe *Opuntia hystrix* Grisebach, collected by C. Wright in Cuba, belongs here, probably being an escape from a garden. Dr. Rose examined the specimens in the Krug and Urban Herbarium in Berlin in 1912; the loose sheaths of the spines of these specimens are now brown, while the flowers seemed a little smaller than those of the Mexican specimens. The flowers were described as red.

Opuntia furiosa Wendland (Pfeiffer, Enum. Cact. 170. 1837) is referred to *O. tunicata* by Pfeiffer, while Salm-Dyck refers it to his variety *O. tunicata laevior* (Cact. Hort. Dyck. 1849. 73. 1850).

Illustrations: Bull. U. S. Dept. Agr. 31 : pl. 4; Cact. Journ. 1 : October; The Garden 62 : 425; Safford, Ann. Rep. Smiths. Inst. 1908: pl. 10, f. 5; Schumann, Gesamtb. Kakteen f. 2; Rep. Mo. Bot. Gard. 22 : pl. 13, 14, these two as *Opuntia perrita*.

Plate X, figure 1, represents a joint of a plant collected by Dr. Rose near Cuzco, Peru. Figure 80 is from a photograph of the same plant.

28. Opuntia pallida Rose, Smiths. Misc. Coll. 50: 507. 1908.

Stems 5 cm. in diameter, about 1 meter high, with widely spreading branches, the whole plant often broader than high; old areoles very spiny, often bearing 20 spines or more, often 3 to 4 cm. long, with white, papery sheaths; young areoles bearing few spines; ovary tuberculate, the areoles either naked or bearing a few bristly spines; flowers pale rose-colored; petals 15 mm. long.

Type locality: Near Tula, Hidalgo, Mexico.

Distribution: State of Hidalgo, Mexico.

This species is known only from near Tula, Mexico, where it was discovered by Dr. J. N. Rose in 1905, and afterwards collected near the same station by Mr. E. W. Nelson. It grows interspersed with *O. imbricata*, but is much lower in stature and has smaller leaves and lighter-colored flowers. It is much like *O. tunicata*, but that species has yellow flowers and is always smaller.

Illustration: Contr. U. S. Nat. Herb. 10 : pl. 17, A.

Figure 81 is from a photograph of the type specimen.

29. Opuntia molesta Brandegee, Proc. Cal. Acad. II. 2 : 164. 1889.

Stems 1 to 2 meters high, or in cultivation only 6 dm. high, with few, long, spreading branches; joints clavate to subcylindric, 10 to 40 cm. long, sometimes as much as 4 cm. in diameter at the top,

M. E. Eaton del. 1, 4, 5
Kako Morita del. 2, 3

1. Joint of *Opuntia tunicata*. 2 to 5. Joints of *Opuntia spinosior*.
(All natural size.)

pale green, with low, broad tubercles, these elongated and often 4 cm. long or more; leaves linear, 10 mm. long or less; spines few, 6 to 10, unequal, the longest ones 2.5 to 5 cm. long, straw-colored, with loose, papery sheaths; flowers purple, 5 cm. in diameter; fruit ovoid, 2.5 cm. long, somewhat spiny or naked; seeds 6 mm. in diameter, irregular in shape.

Type locality: San Ignacio, Lower California.

Distribution: Lower California.

The type of the species is deposited in the Brandegee Herbarium, now a part of the herbarium of the University of California. Living plants have been distributed by A. Berger from La Mortola, Italy, and are now to be found in various collections.

In the Index Kewensis, first supplement, this species is wrongly entered as *Opuntia modesta!*

Figure 82 is from a photograph of a plant sent from La Mortola, Italy, to the New York Botanical Garden in 1913.

FIG. 82.—Opuntia molesta.

Series 7. FULGIDAE.

Much branched, bushy plants, usually with the terminal joints very fleshy, the tubercles broad and low, about as broad as long. The species, of which we recognize five, inhabit the southwestern United States and western Mexico.

KEY TO SPECIES.

Joints very readily detached, freely falling ..... 30. *O. fulgida*
Joints not very readily detached, persistent.
  Spines brown or reddish, at least at base.
    Branches slender; fruit not proliferous . . 31. *O. spinosior*
    Branches stout; fruit proliferous..... 32. *O. prolifera*
  Spines white or yellow.
    Spines white; petals greenish yellow, 1 cm. long or less ..... 33. *O. alcahes*
    Spines yellow; petals red, 2 cm. long..... 34. *O. burrageana*

30. Opuntia fulgida Engelmann, Proc. Amer. Acad. 3: 306. 1856.

Opuntia mamillata Schott in Engelmann, Proc. Amer. Acad. 3: 308. 1856.
Opuntia fulgida mamillata Coulter. Contr. U. S. Nat. Herb. 3: 449. 1896.

Plant sometimes 3 meters high or even more, with a rather definite woody trunk 10 to 20 cm. in diameter, much branched, sometimes almost from the base, and forming a compact flattened crown; terminal joints 10 to 20 cm. long, 3 to 5 cm. in diameter, very succulent, strongly tuberculate, easily breaking off; spines 2 to 12, yellowish to brown, 2.5 to 3.5 cm. long, acicular, covered with loose, papery sheaths; glochids small, whitish to light yellow; flowers light rose, 2.5 to 3 cm. broad; petals few, obtuse; stamens and style very short; fruit at first tuberculate, in age smooth, somewhat pear-shaped, 2 to 5 cm. long, green, usually very proliferous; seeds rather small, 4 mm. broad, often wanting.

Type locality: Mountains of western Sonora, Mexico.

Distribution: Gravelly and sandy situations, southern Arizona, Sonora, and Sinaloa.

We consider *O. mamillata* as synonymous with *O. fulgida;* in herbarium and greenhouse specimens we can find no constant differences. Professor J. J. Thornber, who has long studied this group, says there is no difference between the flowers and fruits, and that there is no difference in distribution (Ariz. Agr. Exp. Sta. Bull. 67: 501). In the field, however, one can see two rather distinct forms which differ in armament, the typical plant being the more spiny.

This is one of the most characteristic opuntias of southern Arizona, being very abundant on the valley slopes and lower foothills. It often forms dense colonies almost to the exclusion of other cacti, or it may be associated with other species, especially of *Opuntia.*

It is a most troublesome plant to come in contact with, for, as the sharp, barbed spines pierce the flesh, the joints easily break loose from the plant and are detached with difficulty from the unfortunate victim.

The flowering season extends from early spring to September. The fruit is markedly proliferous, often developing in chains, and so persisting for several years, possibly eight or ten years, as suggested by Professor D. S. Johnson. They grow in chains of 8 or 9 fruits (12 to 14 have been reported), several chains hanging from a single joint and forming a large cluster. We have seen as many as 38 fruits (40 to 50 have been reported) in a single cluster, and doubtless under favorable conditions many more would be found. These juicy fruits, usually spineless, are much sought by grazing animals.

According to Professor Johnson, who has studied this species several years, the seeds are not known to germinate in nature. Only by cutting away a part of the hard, bony coat could they be made to germinate in the greenhouse. The species is propagated easily by the terminal joints, which come off readily and are transported far and wide like burs, and soon strike root on reaching the soil. New plants are also started occasionally by the fruits themselves.

This species appears to hybridize with *O. spinosior.*

Illustrations: Ariz. Agr. Exp. Sta. Bull. 67: pl. 1, f. 2; Bull. Torr. Club 32: pl. 9, f. 1; Cact. Mex. Bound. pl. 75, f. 18; Gard. and For. 8: f. 46; Hornaday, Camp-fires on Desert and Lava opp. p. 42, 320; Lumholtz, New Trails in Mex. opp. p. 18; Monatsschr. Kakteenk. 18: 153; Nat. Geogr. Mag. 21: 710; N. Mex. Agr. Exp. Sta. Bull. 60: pl. 6, f. 2; Plant World 11^{6}: f. 1, in part; 11^{10}: f. 9, in part; Sargent, Man. Trees N. Amer. f. 559; Ariz. Agr. Exp. Sta. Bull. 67: pl. 5, f. 1; Cact. Mex. Bound. pl. 75, f. 19; Lumholtz, New Trails in Mex. opp. p. 152; Nat. Geogr. Mag. 21: 710; Plant World 11^{6}: f. 1, in part; 11^{10}: f. 9, in part, the last six as *Opuntia mamillata;* Carnegie Inst. Wash. 269: Frontispiece; pl. 1 to 7; pl. 8, f. 76 to 79; pl. 12.

Plate IX, figure 6, represents the proliferous fruit; plate XII, figure 1, is from a photograph taken by Dr. MacDougal near Tucson, Arizona, showing the typical plant to the left and the less spiny plant to the right.

31. **Opuntia spinosior** (Engelmann) Toumey, Bot. Gaz. 25: 119. 1898.

Opuntia whipplei spinosior Engelmann, Proc. Amer. Acad. 3: 307. 1856.

Plants 2 to 4 meters high, tree-like in habit, with a more or less definite, woody trunk, openly branched; ultimate joints 1 to 3 dm. long, 1.5 to 2.5 cm. in diameter, often bright purple, strongly tuberculate; tubercles about 6 to 12 mm. long, longer than broad, more or less flattened laterally; spines 6 to 12, but on old branches sometimes as many as 25, 10 to 15 mm. long, divergent, gray to brownish, covered with thin sheaths; glochids yellowish white; flower-buds short, acute; flowers 5 to 6 cm. broad, purple to pink, yellow, or even white; petals about 10, broad at apex, narrowed at base; style thick, cream-colored or pinkish; ovary tuberculate, bearing small, purple leaves and long, white, easily detached bristles; fruit strongly tuberculate, spineless, yellow, globose to broadly oblong, 2.5 to 4 cm. long, with a depressed umbilicus; seeds white, 4 mm. broad, smooth, with a very indistinct marginal band.

Type locality: South of the Gila River.

Distribution: Arizona, western New Mexico, and northern Mexico.

Opuntia spinosior neomexicana (Toumey, Bot. Gaz. 25: 119. 1898) seems to be a yellow-flowered form of this species. Mr. Toumey writes that his original material of this variety came from the low foothills north of the Rillito River near Tucson.

Opuntia spinosior was described by Engelmann in 1856 as a variety of *O. whipplei,* to which it is only remotely related, but it was not separated until 1898, when it was described as distinct by Professor J. W. Toumey.

Illustrations: Ariz. Agr. Exp. Sta. Bull. 67: pl. 1, f. 1; pl. 5, f. 2; Gard. and For. 9: f. 1; N. Mex. Agr. Exp. Sta. Bull. 60: pl. 7, f. 1; Plant World 11^{10}: f. 7; Sargent, Man. Trees N. Amer. f. 560.

M. E. Eaton del.

1. Leafy branch of *Opuntia imbricata*.
2. Flowering branch of *Opuntia prolifera*.
3, 4. Forms of *Opuntia alcahes*.
5, 6. *Opuntia vestita*.

(All natural size.)

Plate x, figures 2 and 3, are from paintings showing different flower-colors, made at the Desert Laboratory, Tucson, Arizona; figure 4 represents a fruiting joint of a plant collected by F. Gilman at Sacaton, Arizona; and figure 5 represents a leaf-bearing joint of the same plant; plate xii, figure 2, is from a photograph of the plant in the Tucson Mountains, Arizona, by Dr. MacDougal.

32. **Opuntia prolifera** Engelmann, Amer. Journ. Sci. II. 14: 338. 1852.

Stems 1 to 2 meters high, the trunk and old branches terete and woody; terminal joints 3 to 12 cm. long, easily breaking off, fleshy, covered with short, more or less turgid tubercles; spines 6 to 12, brown, 10 to 12 mm. long; glochids pale; flowers small; sepals orbicular, obtuse, dark red; petals red; filaments yellow; style stout; stigma-lobes red; ovary 1 cm. long, strongly tuberculate; upper areoles bearing 2 to 6 reddish spines or the joints naked throughout; fruit proliferous, 3 to 3.5 cm. long and often without seeds; seeds, if present, large, regular, 6 mm. broad.

Type locality: Arid hills about San Diego, California.

Distribution: Southern California and coast of Lower California.

The range of this species is not well known. We have referred here, with some doubt, specimens collected by Dr. Rose on Guadalupe Island, off the coast of Lower California, as well as specimens from the south end of Lower California, but we have seen no flowers from these Lower California collections. A peculiar form less than 5 dm. high with bluish-green joints and small seeds, from near Newport, Orange County, California, deserves further study.

This species, although common in southern California, has never been fully and accurately described. It is often confused in collections with *O. serpentina*, with which it grows, although they are very different.

In greenhouse specimens the joints and spines are not well developed.

Illustration: Meehan's Monthly 3: pl. 1.

Plate xi, figure 2, represents a flowering joint of a plant collected by E. W. Nelson and E. A. Goldman in Lower California, which bloomed at the New York Botanical Garden in April 1914. Figure 83 represents a joint of a plant sent from La Mortola, Italy, in 1912; figure 84 is from a photograph of this plant.

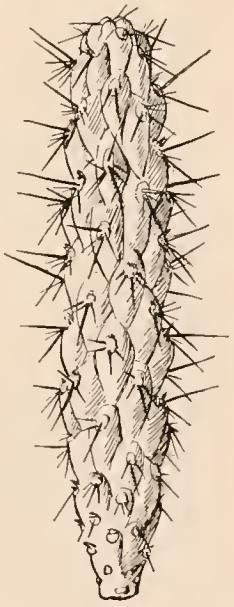


Fig. 83.—Opuntia prolifera.

Of this relationship, but of very different habit, is the species collected by Dr. Rose on West San Benito Island in 1911. Unfortunately no flowers or fruits could be obtained, and hence we have not named it here. It may be briefly characterized as follows:

Opuntia sp.

Low, much branched plants; joints short (10 cm. long), thick, and fleshy; leaves cylindric, 10 mm. long, acute; areoles distant, circular, bearing brown wool, tawny glochids and numerous spines; spines 6 to 8, often 4 cm. long, slender, reddish brown, inclosed in loose, thin, brownish sheaths. Collected by Dr. J. N. Rose on West San Benito Island, off the west coast of Lower California, March 9, 1911 (No. 16043).

33. **Opuntia alcahes** Weber, Bull. Mus. Hist. Nat. Paris 1: 321. 1895.

Plant about 1 meter high, much branched, very spiny, especially when old; branches terete; spines on young joints about 12, short, covered with white or very pale sheaths; tubercles prominent, diamond-shaped; leaves small, 1 cm. long, terete, somewhat bronzed; sepals small, brownish, closely imbricated, hardly spreading at tips; petals sometimes wanting, or, if present, about 1 cm. long, greenish yellow, obtuse; stamens numerous; stigma-lobes very short, 6 to 8, at first exserted beyond the sepals, yellowish; fruit globular, small, becoming turgid in age, yellowish, more or less proliferous, the umbilicus truncated or slightly depressed.

Type locality: In Lower California.

Distribution: Lower California.

Plate XI, figure 3, represents a leaf-bearing joint of a plant obtained by the same collector on Espíritu Santo Island, Lower California; figure 4 is from a plant sent to the New York Botanical Garden from La Mortola, Italy, in 1906. Figure 85 is from a photograph of a plant collected by Dr. Rose at San Francisquito, Lower California.

34. **Opuntia burrageana** sp. nov.

Usually low and bushy, rarely 1 meter high; stems slender, 1 to 2 cm. in diameter, densely spiny; leaves small, 2 mm. long, green, early deciduous; old stem and branches terete; young

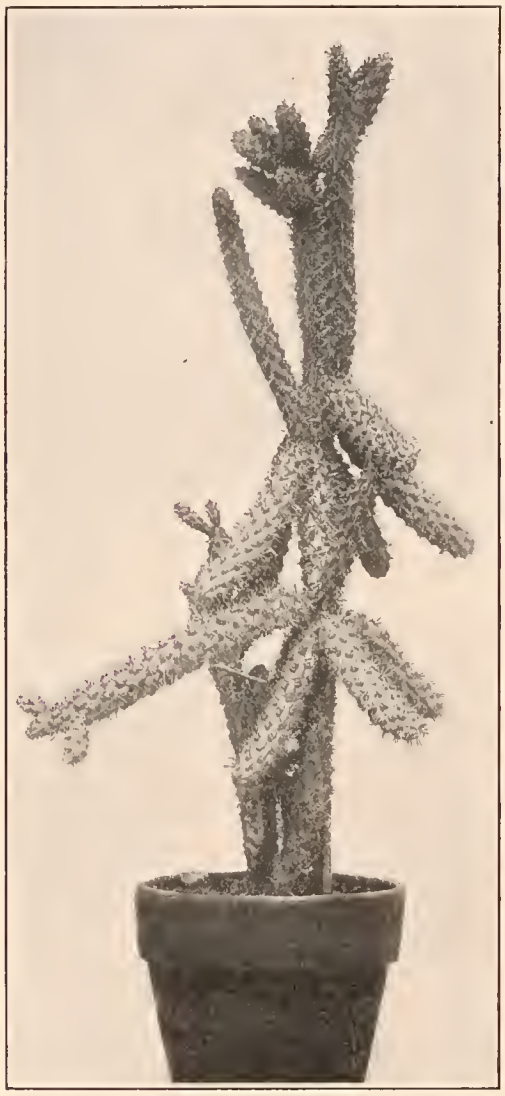


FIG. 84.—Opuntia prolifera

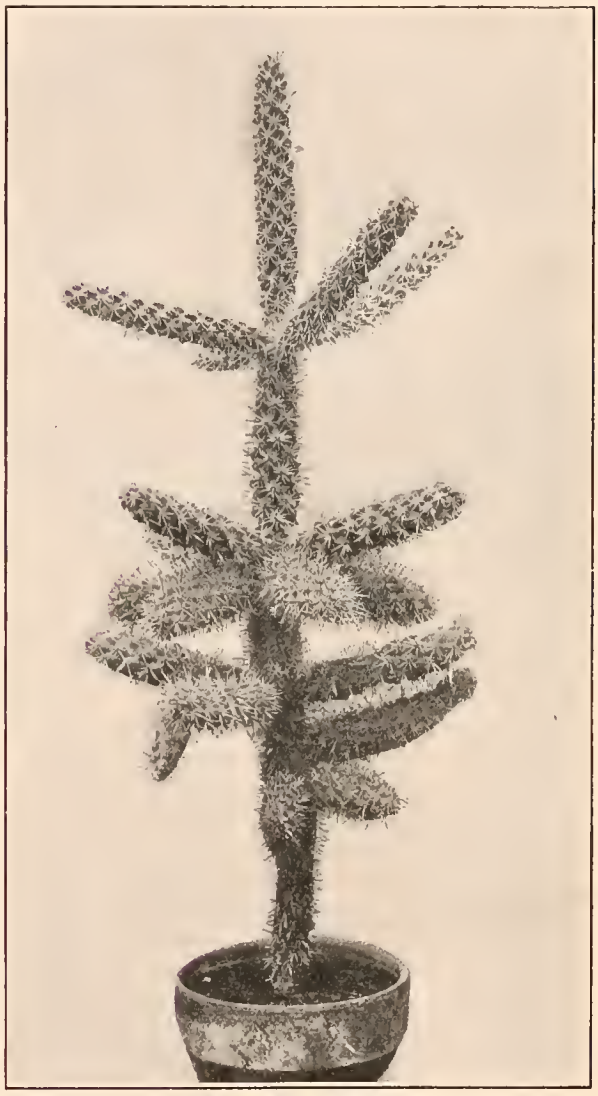


FIG. 85.—Opuntia alcahes.

joints cylindric to narrow-clavate, 15 cm. long or less; areoles closely set; tubercles rather low, not much broader than long; spines numerous, similar, spreading, rarely 2 cm. long, all covered with thin, bright-yellow sheaths; wool in areoles short, brown; glochids, when present, short, light yellow; flower 3 to 4 cm. broad; petals few, brownish red with green bases; filaments green; stigma-lobes white; ovary very spiny; fruit not proliferous, globular, 2 cm. in diameter, somewhat tuberculate, probably dry; seeds pale, 4 mm. in diameter.

Common on the hills along the coast of southern Lower California.

1

2

1. Plants of *Opuntia fulgida*.

2. A very open plant of *Opuntia spinosior*.

The following specimens were collected by Dr. J. N. Rose in 1911: Near Pichilinque Island (No. 16533, type); near San José del Cabo (No. 16468); near Cape San Lucas (No. 16379); on Carmen Island (No. 16630); on San Josef Island (No. 16552).

Plate XIV, figure 1, is from a plant collected by Dr. Rose on San Josef Island, Lower California, in 1911, which flowered the next year at the New York Botanical Garden.

Series 8. VESTITAE.

The series *Vestitae* contains three or perhaps four species, two of which possibly represent greenhouse forms of species of *Tephrocactus*, natives of the high Andes. They are low species with elongated cylindric joints sometimes arising from subglobose ones, and form a connecting link between the true species of *Tephrocactus* and *Cylindropuntia*. *Opuntia vestita* in the field was supposed to be a form of *O. pentlandii*, but in cultivation it has developed quite differently: *O. floccosa*, a *Tephrocactus*, sometimes develops like the *Vestitae;* one specimen which we have grown shows a slender cylindric stem with few long hairs or none. *Opuntia boliviana* and *O. pentlandii*, both from Bolivia and described at the same time by Salm-Dyck, and which we have united, seem to represent two forms of the same species, *O. pentlandii* being the abnormal form. The same condition seems to exist in *O. verschaffeltii* and its variety *digitalis*, the variety being the normal form. Schumann had these species in his series *Teretes* (our series *Subulatae*), but *O. subulata* and *O. cylindrica* are tall woody, much branched plants.

Key to Species.

Areoles with hairs; joints not or scarcely tuberculate.
- Joints 1 to 1.5 cm. thick; spines 2.5 cm. long or less; fruit mostly sterile . . . 35. *O. vestita*
- Joints 2.5 to 3 cm. thick; spines up to 5 cm. long; fruit many-seeded . . . 36. *O. shaferi*

Areoles without hairs; joints distinctly tuberculate . . . 37. *O. verschaffeltii*
- Of this series? . . . 38. *O. hypsophila*

35. **Opuntia vestita** Salm-Dyck, Allg. Gartenz. 13: 388. 1845.

Opuntia teres Cels in Weber, Dict. Hort. Bois 898. 1898.

Roots fibrous; stems much branched, weak, forming small clumps 3 dm. broad or less and nearly as high, fragile; joints short or elongated, becoming in greenhouse cultivation 2 dm. long or more, oblong or cylindric, 1 to 1.5 cm. thick, very spiny, easily breaking apart; areoles circular, conspicuous, bearing short wool, spines, and several long hairs; spines about 6 in each cluster, acicular, brownish, 2 to 2.5 cm. long; leaves minute, acute; flowers small, including the ovary; 2 cm. long, deep red; petals 1 cm. long; areoles on ovary conspicuous, filled with white wool and long hairs; fruit red, usually sterile, globular or a little longer than broad, usually naked, generally truncate at apex, often bearing small spiny joints at the areoles.

Type locality: In Bolivia.

Distribution: Common on the sterile hills about La Paz, Bolivia.

Specimens were collected by Miguel Bang some years ago and segregated as a new species by the late Karl Schumann, but this was never published; others were obtained by Dr. H. H. Rusby in 1885, and by R. S. Williams in 1901. It was again collected by Dr. Rose in 1914, and living plants are now growing at the New York Botanical Garden. As seen wild, it is a strange little plant, growing in low clumps, its fragile stems easily breaking apart, especially at the terminal joints. The bright red fruits remain on the parent plant until they produce a number of spiny joints, often as many as five, which, after falling off, strike roots and start new colonies.

Dr. Rose suspected at the time he collected his material that it might be *Opuntia vestita*, and suggested that it should be carefully compared with it. This he was not able definitely to prove in the field, but the living specimens sent to the New York Botanical Garden put out new branches which are long, slender, and cylindric, and are devoid of long acicular spines, quite unlike the wild plants but almost identical with the specimens received from La Mortola, Italy, some years ago as *O. vestita*.

Opuntia teres Cels must belong here, at least in part. Weber states that the flowers are very similar to *O. vestita*, while the fruit is said to be small, red, and proliferous, just as found in *O. vestita*. The leaves are described as 2 cm. long, however, and there is a possibility that *O. exaltata* may be partly represented in the description, as we find herbarium material of both species, from Bolivia, mounted on the same sheet.

Plate XI, figure 5, shows the plant collected by Dr. Rose in 1914; figure 6 is from a plant received from La Mortola, Italy, in 1912.

36. **Opuntia shaferi** sp. nov.

Plants in clusters of 2 to 4, erect, about 3 dm. high; joints terete, 2.5 to 3.5 cm. in diameter, elongated, very spiny; tubercles low, often indistinct; leaves deciduous, 6 mm. long; areoles 1 cm. apart or less, circular, white-felted; glochids numerous, whitish from the upper margin of the areole; spines about 6 at an areole, brownish, acicular, often 4 to 5 cm. long and associated with long white hairs; flowers not known; fruit globular, about 2 cm. in diameter, bearing numerous large areoles, the areoles white-felted, with glochids and hairs, but no spines; seeds turgid, pointed at base, 4 mm. long.

Collected by J. A. Shafer among stones between Purmamaria and Tumbaya, Argentina, February 6, 1917 (No. 90).

Nearest *O. vestita* but less cespitose, taller and larger, and with fertile fruit.

37. **Opuntia verschaffeltii** Cels in Weber, Dict. Hort. Bois 898. 1898.

Opuntia verschaffeltii digitalis Weber, Dict. Hort. Bois 898. 1898.

Forms low, in dense clumps, much branched; joints globular to short-cylindric, 1 to 4 cm. long, somewhat tuberculate, pale green; spines 1 to 3, yellowish, weak, and bristle-like, 1 to 3 cm. long; in cultivated plants joints elongated, 6 to 21 cm. long, slender, 1 to 1.5 cm. in diameter, strongly tuberculate, spineless; glochids few, white; areoles narrow, longer than broad, filled with short white wool.

Type locality: In Bolivia.

Distribution: Bolivia.

In 1914 Dr. Rose collected this species on the barren hills about La Paz, Bolivia, and from his observations it seemed to be only a form of *Opuntia pentlandii*. In cultivation, however, it behaves very differently from his specimens of the latter, and in fact has developed a phase very unlike its normal type but identical with other greenhouse specimens sent out by Mr. Berger some years ago under the name of *O. verschaffeltii*.

Opuntia digitalis Weber (Dict. Hort. Bois 898. 1898) was given as a synonym of *O. verschaffeltii digitalis*.

Figure 86 represents an elongated joint, from a greenhouse specimen; this grew from the short normal joint, collected by Dr. Rose near La Paz, Bolivia, in 1914.

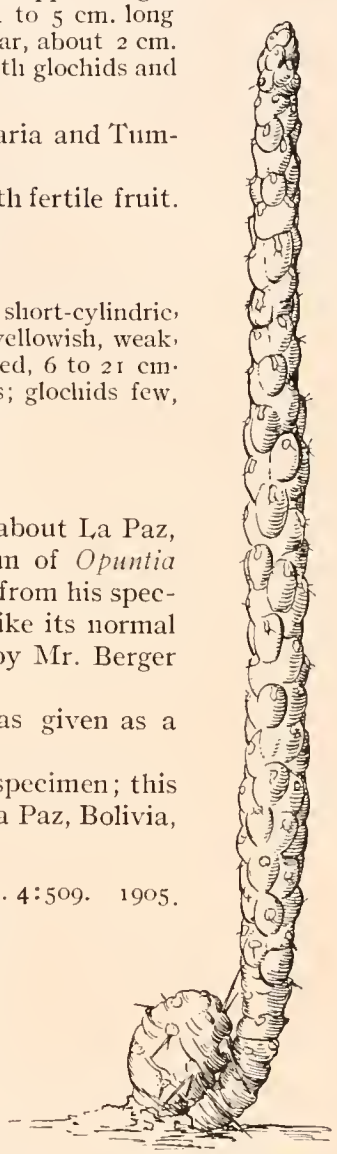


FIG. 86.—Opuntia verschaffeltii. ×0.66.

38. **Opuntia hypsophila** Spegazzini, Anal. Mus. Nac. Buenos Aires III. 4:509. 1905.

Cespitose, branching, small, 5 to 10 cm. high, pale green; joints globose to cylindric, 1.5 to 3 cm. long; tubercles depressed; spines 3 to 5, subulate, weak, spreading, white at first, in age brownish; flowers and fruit unknown.

Type locality: In the Province of Salta, Argentina, in the Andes, at an altitude of 2,500 to 4,000 meters.

Distribution: Salta, Argentina.

We do not know this species, but Dr. Spegazzini thought it might be a *Tephrocactus* and associated it with *Opuntia verschaffeltii digitalis*.

Series 9. CLAVARIOIDES.

This series is the same as the *Eluberculatae* of Schumann and contains but a single species, recorded as a native of Chile. According to Schumann, the stems are cylindric to clavate, not tuberculate, the leaves are small and caducous, and the spines are very small and appressed. The fruit is said to contain one woolly seed.

39. **Opuntia clavarioides** Pfeiffer, Enum. Cact. 173. 1837.

Low, much branched, grayish brown, 4 dm. high or less, truncate or cristate at apex; joints not tuberculate, rather fragile, short-cylindric or clavate, 1.5 cm. in diameter; leaves minute, 1.5 mm.

long, reddish, caducous; areoles minute, closely set, filled with wool and minute spines; spines 4 to 10, white, appressed; flowers 6 to 6.5 cm. long; sepals linear, pointed, reddish; petals light brown, narrowly spatulate, slightly crenate; ovary bearing minute leaves with wool and short bristles in their axils; filaments white, shorter than the petals; style white, with 7 stigma-lobes; fruit ellipsoid, 1.5 cm. long, one-seeded.

Type locality: In Chile.

Distribution: Originally described from Chile, but often referred to Mexico.

Very little is known of this species, although it was described as long ago as 1837, and it is rare in collections. We have never seen it in flower and have seen only one record of its flowering in cultivation. The peculiar structure of the stem, narrow petals and single lanate seed, join a combination of characters separating it from other opuntias, and lead Schumann to refer it to a distinct series which he calls *Etuberculatae*. The question has been raised in our own minds if this is a true *Opuntia*. In cultivation the plant is usually grafted on some *Platyopuntia*.

Variety *cristata* is offered in the trade journals.

Opuntia microthele, *Cereus clavarioides*, and *Cereus sericeus* are usually given as synonyms, but all these were cited by Pfeiffer (Enum. Cact. 173. 1837) as synonyms of this species at the place commonly given as their first publication. The varieties *fasciata* Schumann (Monatsschr. Kakteenk. 10: 159. 1900), *fastigiata* Mundt (Monatsschr. Kakteenk. 3: 30. 1893), and *monstruosa* Monville (Labouret, Monogr. Cact. 489. 1853) are anomalous greenhouse forms.

Illustrations: Gartenflora 44: f. 7; Monatsschr. Kakteenk. 3: 9; 16: 169; Schumann, Gesamtb. Kakteen f. 104; Gard. Chron. III. 30: f. 75, this last as *Opuntia clavarioides cristata*.

Figure 87 is copied from the illustration used by Schumann cited above.

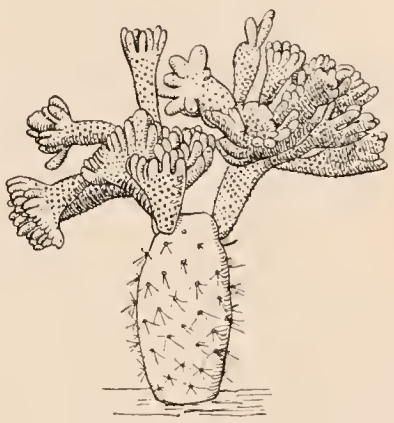


FIG. 87.—Opuntia clavarioides grafted on another species.

Series 10. SALMIANAE.

This series (*Frutescentes* of Schumann), by some supposed to be composed of five species but here treated as containing but one, is confined to central South America. It is characterized by slender, bushy, often vine-like habit, terete branches, and red fruit, the latter crowned by proliferous spiny joints. Seeds are unknown. Greenhouse specimens often resemble *Opuntia leptocaulis*, but the flowers are somewhat larger, and the spines are not sheathed.

40. Opuntia salmiana Parmentier in Pfeiffer, Enum. Cact. 172. 1837.

Opuntia spegazzinii Weber, Dict. Hort. Bois 898. 1898.
Opuntia albiflora Schumann, Gesamtb. Kakteen Nachtr. 152. 1903.

A bushy plant, 3 dm. to 2 meters high, much branched at base; branches often weak, terete, 1.5 cm. in diameter or less, often purplish, etuberculate; areoles small, bearing wool, yellow glochids, and spines; spines sometimes wanting, usually several, 1.5 cm. long or less, white; flowers 2 to 3.5 cm. broad, scattered along the stem; buds pinkish or even scarlet; petals obovate, pale yellow to white, sometimes tinged with pink; stamens and style short; stigma-lobes yellowish green; fruits sterile, clavate, scarlet, with few or no spines.

Type locality: In Brazil.

Distribution: Southern Brazil, Paraguay, and northern Argentina.

After careful consideration, we have combined three species of Schumann's series *Frutescentes* into one. We have examined considerable living material and all the illustrations, but have found no grounds for separating the group into species. All were described as proliferous and sterile. *O. spegazzinii* was supposed to be unarmed, but this

character is not constant; flower differences are described, but these are inconstant. One species, *O. albiflora*, has already been referred to synonymy.

Opuntia salmiana is said to have come from Brazil, but no definite locality is given for it, and it has not been collected there in recent times. If really from Brazil, and there is no good reason to question this reference, it is doubtless from the southern part, possibly on the border of Paraguay; indeed, *O. albiflora*, one of the three, was described from a Paraguay collection; the other, *O. spegazzinii*, is a native of the deserts of northern Argentina.

Cactus salmianus Lemaire (Cact. 87. 1868, name only) has been referred here as a synonym; as has also *O. floribunda* Lemaire (Cact. Gen. Nov. Sp. 68. 1839).

Opuntia schickendantzii Weber, included by Schumann in this relationship, we refer to our series *Aurantiacae*.

FIG. 88.—Opuntia salmiana.

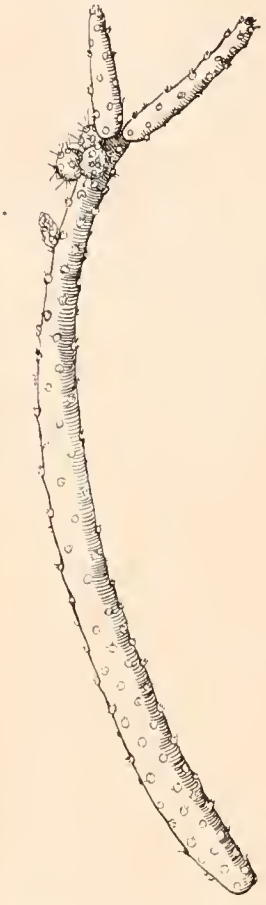


FIG. 89.—O. salmiana. ×0.6.

Opuntia wagneri Weber in Gosselin (Bull. Mus. Hist. Nat. Paris 10: 393. 1904), described without flower or fruit, is probably to be referred here; at least Roland-Gosselin believed it to be of this group. We have not seen any of the specimens from Chaco, Argentina, obtained by M. Emile Wagner in 1902.

Illustrations: Blühende Kakteen 3: pl. 123; Curtis's Bot. Mag. 76: pl. 4542; Fl. Serr. 7: pl. 670; Jard. Fleur. 2: pl. 194; Loudon, Encycl. pl. ed. 3. f. 19406; Pfeiffer and Otto, Abbild. Beschr. Cact. 1: pl. 6; Castle, Cactaceous plants f. 15; Blühende Kakteen 2: pl. 103, this last as *Opuntia spegazzinii;* Hogg, Veg. King. 340. f. 111.

Figure 88 is from a plant in the greenhouses of the United States Department of Agriculture at Washington; figure 89 represents a joint of a plant collected by Dr. Rose at Córdoba, Argentina, in 1915.

OPUNTIA MALDONADENSIS Arechavaleta, Anal. Mus. Nac. Montevideo 5: 286. 1905.

Cespitose, erect; branches cylindric, entangled or intertwined; joints 3 to 10 cm. long, about 2 cm. in diameter, the terminal ones obovate-spherical, dark green to olive-colored; areoles each surrounded by a violet blotch, small or prominent, orbicular; spines 5 or more, stout, spreading, elongated, unequal, the longest one 2 to 2.5 cm. long, reddish to brown; flowers and fruit unknown.

Type locality: Punta Ballena, near Maldonado, Uruguay.

Distribution: Uruguay.

This species, referred to the subgenus *Cylindropuntia* by Arechavaleta, inhabits the coast of Uruguay and is known to us only from description; we append it to the series *Salmianae*, but its nearest relationship may be elsewhere.

Series 11. SUBULATAE.

This series is confined to South America and represents a very distinct group, differing greatly from the tall cylindric-jointed species of North America. They lack sheaths to the spines, and the typical species has elongated persistent leaves. Although several of the species have long been in cultivation, at least two of them being known only from garden plants; for a long time the flowers were unknown and the plants were as frequently called *Cereus* or *Pereskia* as *Opuntia*.

KEY TO SPECIES.

Leaves long-persisting, elongated.
- Leaves up to 12 cm. long; spines yellowish white ..... 41. *O. subulata*
- Leaves 1 to 7 cm. long; spines brownish ..... 42. *O. exaltata*

Leaves early deciduous, short.
- Stem 1 meter high; leaves 4 mm. long ..... 43. *O. pachypus*
- Stem 3 to 4 meters high; leaves 10 to 13 mm. long ..... 44. *O. cylindrica*

41. Opuntia subulata (Mühlenpfordt) Engelmann, Gard. Chron. 19: 627. 1883.

Pereskia subulata Mühlenpfordt, Allg. Gartenz. 13: 347. 1845.
Opuntia ellemeetiana Miquel, Nederl. Krudk. Arch. 4: 337. 1858.*
Opuntia segethii Philippi, Bot. Zeit. 26: 861. 1868.

Either with a simple erect stem or with several main branches from the base, 2 to 4 meters high; trunk 6 to 10 cm. in diameter, the old bark smooth and brown, its areoles bearing clusters of 8 spines or more; branches numerous, more or less clustered but not whorled, at first almost at right angles to main stem but soon erect, bright green; leaves persistent, green, nearly at right angles to branch, straight or somewhat bowed above, nearly terete, pointed, 5 to 12.5 cm. long, grooved on the under side; tubercles large, depressed, becoming obliterated on old branches, arranged in longitudinal or spiral lines, more or less diamond-shaped, but retuse at apex and pointed or attentuate below, 2 to 4 cm. long; areoles in the retuse grooves of the tubercles bearing a few short yellow spines or sometimes spineless, but usually having 1 or 2 slender spines; flowers borne toward the ends of the branches; sepals reddish, minute, 4 to 8 mm. long or less; petals broader than the sepals, orange or greenish yellow; style rose-red except the whitish base, including the stigma-lobes about 3 cm. long, about as long as the longest stamens; stigma-lobes 5 or 6, slender, orange-yellow; fruit oblong, more or less persistent, 6 to 10 cm. long, leafy, with a deep umbilicus, sometimes proliferous; seeds few, 10 to 12 mm. long.

Type locality: Valparaiso, Chile, but doubtless described from cultivated plants.

Distribution: Chile is usually given as the home of this plant, but it is not found wild there. It may be a native in Argentina.

This species has long been in cultivation, it having originally been sent from Valparaiso, but Dr. Rose did not find it wild there or in any other part of Chile. It is rarely seen in cultivation in Chile. For many years it passed as a species of *Pereskia*, but in 1883 Dr. George Engelmann pointed out that it could not be retained in that genus and transferred it to *Opuntia*. The leaves are the largest in the genus, and it has larger seeds than any other *Opuntia*.

We have referred *Opuntia ellemeetiana* (originally described from Chile), a species with very long leaves, to *O. subulata*, although we have never seen specimens. Schumann did not know it and only lists it.

*Schumann says 1859.

We have been able more definitely to refer here *Opuntia segethii*, for we saw not only Philippi's type specimens in his herbarium, but also living specimens grown from Philippi's original stock. The type specimen was from plants cultivated at Santiago, but in a later publication he states that his species grows spontaneously near Arequipa. A part of this latter material is preserved in his herbarium at Santiago, which Dr. Rose was able to study; he also examined the Arequipa plant alive, and is convinced that it is quite different, being the plant common in Peru and Bolivia described below as *Opuntia exaltata*.

Illustrations: Engler and Prantl, Pflanzenfam. 3^{6a}: f. 56, L; Gard. Chron. III. 34: f. 33, 38; Monatsschr. Kakteenk. 8: 7; 9: 183; Schumann, Gesamtb. Kakteen f. 103; Neub. Gart. Mag. 1893: 291, this as *Pereskia subulata;* Bot. Zeit. 26: pl. 13, C. f. 1; Gartenflora 32: pl. 1129, f. 5, the last two as *Opuntia segethii*.

Figure 90 is from a photograph of a plant at the New York Botanical Garden grown from a cutting brought by Mrs. H. L. Britton from the Riviera, Italy, in 1907.

42. **Opuntia exaltata** Berger, Hort. Mortol. 410. 1912.

Stem 2 to 5 meters high, with a definite trunk 5 to 30 cm. in diameter when well grown, much branched; ultimate joints fleshy, easily detached, somewhat curved upward, clavate, strongly tuberculate; tubercles large, 1.5 to 3 cm. long, more or less diamond-shaped, elevated, and rounded; areoles rounded, filled with short white wool; glochids often wanting, when present brown; leaves fleshy, terete, 1 to 7 cm. long; spines on young joints 1 to 5, mostly 1 to 3, dark yellow or brownish, unequal, the longest ones 5 cm. long; spines on old wood numerous, sometimes 12 or more, often 13 cm. long, brown, with roughened tips; flowers, including ovaries, 7 cm. long; sepals and petals brick-red; outer sepals ovate, small, the inner ones passing into petals; petals 2 cm. long, broadly obovate to broadly spatulate, sometimes nearly truncate at apex; stamens numerous, short, pinkish above, nearly white below; style swollen below, pinkish; stigma-lobes greenish; ovary 4 cm. long, deeply umbilicate, with large flat tubercles; areoles on ovary circular, filled with short brown and white wool, long, loosely attached brown spines, and a few shorter glochids, and subtended by small, tardily deciduous leaves; fruit green, pear-shaped, 9 cm. long, usually sterile; seeds large, irregular, 10 mm. broad.

FIG. 90.—Opuntia subulata.

Type locality: Not cited; described from cultivated plants.

Distribution: Ecuador, Peru, Bolivia, and probably northern Chile.

This *Opuntia* is called pataquisca by the Cuzco and Arequipa Indians, and is also known as espina.

This species was the most widely distributed *Opuntia* seen by Dr. Rose on the west coast of South America; but it is difficult to decide whether it is really native there, for it is widely cultivated as a hedge plant in many places. It seems to be native along the upper Rimac of central Peru; at least it is well established on the hills. Although very common in southern Peru and about La Paz, Bolivia, it is probably introduced for it grows only about towns and cultivated fields and seems never to produce fertile fruit. About Cuzco it is likewise cultivated, but may be a native there also, for the fruit is generally fertile.

1

2

1. *Opuntia exaltata* as seen in the highlands of Peru.
2. Clump of *Opuntia floccosa* as it grows in the valleys of the Andes of eastern Peru.

Opuntia maxillare Roezl (Morren, Belg. Hort. 24: 39. 1874), published without description and probably collected in the high mountains above Lima, may belong here.

Opuntia cumingii, of European gardens, belongs here. It was briefly mentioned in the journal of the Berlin Cactus Society (Monatsschr. Kakteenk. 7: 160. 1897), but not formally described. Schumann referred it to *O. pentlandii*.

This species is near *Opuntia subulata*, but probably is distinct, although it is not always easy to distinguish them in greenhouse plants. Berger speaks of the similarity of the two as follows:

"This new species stands very close to *O. subulata*, and may be easily mistaken for it, but when grown side by side the differences are quite obvious. *O. exaltata* is a taller plant with generally longer branches, and somewhat glaucous instead of grass-green. The tubercles are more elongated and differently marked. The leaves are shorter, the spines, when young, are not white, but yellowish brown, generally stouter and stiffer. I have not yet seen a flower of it. It is an old inhabitant of our gardens."

Plate XIII, figure 1, is from a photograph taken by Hiram Bingham, July 7, 1912, near Tipon, Cuzco Valley, Peru, showing the plant near the upper left-hand corner; plate XV, figure 1, represents a leaf-bearing joint of a plant sent to the New York Botanical Garden from La Mortola, Italy, in 1915; figure 2 represents the lower part of a fruiting branch obtained by Dr. Rose at Cuzco, Peru, in 1914.

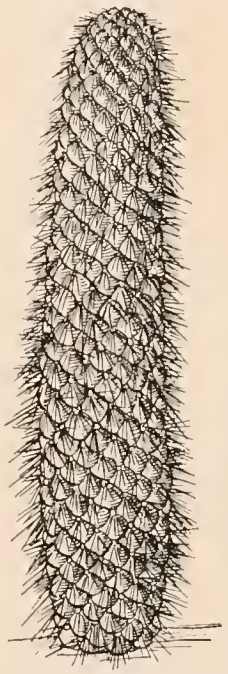


FIG. 91.—Opuntia pachypus.

43. **Opuntia pachypus** Schumann, Monatsschr. Kakteenk. 14: 26. 1904.

Plant about 1 meter high, much branched and candelabrum-like; branches cylindric, 3 to 5 cm. in diameter, either straight or curved, marked with broad tubercles; leaves subulate, pointed, constricted at the base, 4 mm. long, early deciduous; areoles circular, borne at the upper edges of the tubercles, 4 mm. in diameter, filled with short wool; spines 20 to 30, subulate, 5 to 20 mm. long; glochids yellow; flowers scarlet, 7 cm. long, including the ovary; petals variable, the longest ones 1.4 cm. long; style very thick, 9 mm. long; stigma-lobes 5 mm. long; ovary more or less spiny.

Type locality: Near Santa Clara, Peru.

Distribution: Central Peru, near the coast.

We know this species only from the description and illustrations. In 1914 Dr. Rose made several unsuccessful efforts to find it at Santa Clara, the type locality.

Illustrations: Engler and Drude, Veg. Erde 12: pl. 5[b]; Monatsschr. Kakteenk. 14: 27. Figure 91 is copied from the second illustration above cited.

44. **Opuntia cylindrica** (Lamarck) De Candolle, Prodr. 3: 471. 1828.

Cactus cylindricus Lamarck, Encycl. 1: 539. 1783.
Cereus cylindricus Haworth, Syn. Pl. Succ. 183. 1812.

More or less branched, 3 to 4 meters high, the old trunk becoming smooth; joints cylindric, obtuse at apex, green, with slightly elevated tubercles; leaves deciduous, 10 to 13 mm. long, terete, acute; areoles depressed, filled with white wool, bearing some long hairs and at first 2 or 3, afterwards more, short white spines (spines often wanting on greenhouse plants); flowers appearing just below the ends of the terminal branches, small, inconspicuous, about 2.5 cm. broad, scarlet; petals small, erect, obtuse; stamens numerous; style slender, 2.5 cm. long; ovary strongly tuberculate, depressed at apex; fruit about 5 cm. long, yellowish green; seeds more or less angled, 4 to 6 mm. in diameter.

Type locality: In Peru.

Distribution: Highlands of Ecuador and Peru.

The home of this species is usually given by recent writers as Chile, but Lamarck, who described it first in 1783, said it came from Peru. Dr. Rose, who visited Peru and Chile in

1914, was not able to find it wild in either country but found it abundant in Ecuador in 1918. This species was introduced into England in 1799, but flowers were not known until about 1834.

There are two abnormal forms in cultivation which are offered under the names variety *cristata* and *monstruosa*. Several varieties of this species are given in catalogues: *cristata* (Haage and Schmidt, Haupt-Verzeichnis 1908: 228. 1908); *cristata minor* Haage and Schmidt (Verzeichnis Blumenzwiebeln 1913: 37. 1913); and *robustior* (Haage and Schmidt, Haupt-Verzeichnis 1908: 228. 1908).

Illustration: Curtis's Bot. Mag. 61: pl. 3301; Carnegie Inst. Wash. 269: pl. 10, f. 88.

Plate XIV, figure 2, shows a leaf-bearing top of a plant grown at the New York Botanical Garden.

Series 12. MIQUELIANAE.

Bushy plants, with elongated cylindric bluish joints; tubercles large, elevated; leaves minute, early deciduous. The series consists of but one species, confined to the deserts of northern Chile.

45. Opuntia miquelii Monville, Hort. Univ. 1: 218. 1840.*

Opuntia pulverulenta Pfeiffer, Allg. Gartenz. 8: 407. 1840.
Opuntia pulverulenta miquelii Salm-Dyck, Cact. Hort. Dyck. 1844. 49. 1845.
Opuntia geissei Philippi, Anal. Univ. Chile 85: 492. 1894.
Opuntia rosiflora Schumann, Gesamtb. Kakteen 686. 1898.

Often growing in colonies 2 to 5 meters broad; stems cylindric, much branched, usually less than 1 meter high, but occasionally 1.5 meters high, with numerous lateral branches; branches rather short, usually only 8 to 20 cm. long, thick (5 to 6 cm. in diameter); old branches bluish green, with low tubercles sometimes 2 cm. long; young joints bright green, with high tubercles flattened laterally; spines tardily developing, but formidable on old branches, very unequal, in clusters of 10 or more, the longest ones nearly 10 cm. long, whitish in age; glochids numerous, brownish, caducous; leaves minute, 2 to 3 mm. long; areoles circular, when young filled with white wool, in age somewhat elevated on the areoles; flowers rather variable in length, 4 to 8 cm. long including the ovary, rose-colored to nearly white; petals broad, apiculate, 2 to 2.5 cm. long; filaments rose-colored; ovary strongly tuberculate; areoles filled with numerous brown glochids and subtended by minute leaves; style white; stigma-lobes green; fruit ovoid to oblong in outline, nearly white; umbilicus truncate; seeds small, 4 mm. broad.

Type locality: In South America, but no definite locality.

Distribution: Province of Atacama, Chile.

Opuntia miquelii and *O. pulverulenta* have long been considered identical. We have not seen the types of either, but are following such authorities as Salm-Dyck (in 1850), Labouret (1853), and Rümpler (1885) in uniting them. They seem to have been published in the same year.

Opuntia geissei, according to a statement made to Dr. Rose by Juan Söhrens, of Santiago, is the same as *O. miquelii*, and this the former was able to verify by later herbarium and field studies.

Opuntia rosiflora Schumann was based on Philippi's unpublished name *O. rosea;* while *O. rosea* was made by Philippi the type of *O. geissei*. This is clearly shown by Philippi's herbarium, where he has erased the name *O. rosea* and substituted *O. geissei*. Dr. Rose also obtained from William Geisse a part of Philippi's original specimen, which came, as the label states, from near Bandurrias, in the valley of Carrizal, in the Province of Atacama. Later on, while making field observations in Atacama, Dr. Rose found this species very common from north of Castillo to Vallenar. This is in the general region of *O. geissei* (*O. rosea* and *O. rosiflora*) and in the river valley of the Huasco. Huasco, the type locality of *O. miquelii*, is 25 miles lower down this valley, and we have no hesitancy in uniting them all.

Although this species is not uncommon in cultivation, it has rarely been seen in flower, and we believe that the fruit has not heretofore been described.

*Schumann states that this book was published in 1839.

M. E. Eaton del

1. Flowering branch of *Opuntia burrageana*.
2. *Opuntia cylindrica*.
3, 4. Joints of *Opuntia stanlyi*.
5. Flowering joint of *Opuntia macrorhiza*.

(All natural size.)

Dr. Rose observed a single plant infested by *Loranthus aphyllus*, the parasite which is so abundant on *Cereus chiloensis*.

Opuntia heteromorpha Philippi (Anal. Mus. Nac. Chile 1891[2]: 28. 1891) we refer here on the authority of Schumann, but we have seen no specimens, the type specimen being missing from the Philippi herbarium in Santiago; it was collected at Chiquito, Tarapaca, Chile.

Dr. Weber thought that *Opuntia segethii* belonged here, but we have referred it to *O. subulata*.

Opuntia carrizalensis Philippi is only mentioned by Schumann (Gesamtb. Kakteen Nachtr. 152. 1903). It is doubtless to be referred here.

Plate XVI, figure 1, is from a plant collected by Dr. Rose at Vallenar, Chile, in 1914.

Series 13. CLAVATAE.

Here we include nine prostrate or spreading, low species, natives of the southwestern United States and Mexico, characterized by clavate joints and by sheathless spines, although rudimentary sheaths have been observed on young spines in some of the species; they appear to form a transition between the subgenus *Cylindropuntia* and the South American subgenus *Tephrocactus*, from which they differ essentially in having clavate joints.

KEY TO SPECIES.

Spines flattened.
- Stems very stout.
  - Stems hardly clavate; ovary very prickly ..... 46. *O. invicta*
  - Stems strictly clavate; ovary only slightly prickly ..... 47. *O. stanlyi*
- Stems more slender and weak.
  - Spines brown, slender, long (4 to 6 cm. long) ..... 48. *O. schottii*
  - Spines stout, white, when old very flat.
    - Bristles on ovary and fruit white ..... 49. *O. clavata*
    - Bristles on ovary and fruit brown ..... 50. *O. parishii*

Spines terete, elongated, and flexible, or the central ones somewhat flattened.
- Flowers pinkish or purple.
  - Bristles on ovary numerous, brown ..... 51. *O. pulchella*
  - Bristles on ovary few, white ..... 52. *O. vilis*
- Flowers yellow.
  - Spines comparatively short, swollen at base ..... 53. *O. bulbispina*
  - Spines long and flexible, not swollen at base ..... 54. *O. grahamii*

46. Opuntia invicta Brandegee, Proc. Calif. Acad. II. 2: 163. 1889.

Plants growing in large clusters 2 meters in diameter and 2 to 5 dm. high, with many ascending or spreading branches; joints obovoid to clavate, dark green, 8 to 10 cm. long, strongly tuberculate; tubercles large, flattened laterally, 3 to 4 cm. long; areoles large, 1 to 1.5 cm. in diameter; leaves linear, 8 to 14 mm. long, reddish, curved, acute, deciduous; spines very formidable, when young reddish or purple with carmine-red bases, chestnut-brown at tips and grayish between, but in age dull in color; radial spines 6 to 10; central spines 10 to 12, much stouter than the radials, strongly flattened; wool white; glochids few, white, 2 to 4 mm. long; flowers yellow, 5 cm. in diameter; sepals ovate, acuminate; ovary 2 cm. in diameter, almost hidden by the numerous reddish, acicular spines; seeds yellowish, 2 mm. broad.

Type locality: About San Juanico, Lower California.

Distribution: Central Lower California, at low elevations.

Mr. Brandegee has called attention to the strong resemblance in habit of this species to some of the species of *Echinocereus*, and Dr. Rose states that when he first saw it he supposed it to be some strange *Echinocereus*. It grows in great tufted masses and does not suggest in the remotest degree any of our North American opuntias. The species clearly belongs to Engelmann's series *Clavatae*, where it was placed by Schumann, who associated it with *O. cereiformis*, but it is undoubtedly much nearer to *O. stanlyi*. So far as we know, the plant has never been in the trade; it does not succeed well in cultivation. Considerable living material was brought back by the *Albatross* in 1911, most of which was sent to the New York Botanical Garden; but some of the plants were sent to collections at St. Louis, Washington, and Los Angeles.

Illustration: Cact. Journ. 1: February.

Plate XVI, figure 2, represents a plant collected by Dr. Rose at San Francisquito, Lower California, in 1911.

47. **Opuntia stanlyi** Engelmann in Emory, Mil. Reconn. 158. 1848.

Opuntia emoryi Engelmann, Proc. Amer. Acad. 3: 303. 1856.
Opuntia kunzei Rose, Smiths. Misc. Coll. 50: 505. 1908.

Stems low, usually less than 3 dm. high, much branched, creeping, forming broad, impenetrable masses 2 to 3 meters in diameter; joints 10 to 15 cm. long, clavate, more or less curved, strongly tuberculate; tubercles 3 to 4 cm. long, flattened laterally, 4 to 6 cm. apart; spines numerous, stout, elongated, somewhat roughened, reddish brown, the larger ones strongly flattened, 3.5 to 6 cm. long; flowers yellow, 5 to 6 cm. broad; fruit ovate, clavate at base, yellow, 5 to 6 cm. long, very spiny, with a depressed umbilicus; seeds flattened, 4.5 to 6.5 mm. in diameter.

Type locality: On the del Norte and Gila, New Mexico.

Distribution: Southwestern New Mexico to eastern Arizona and adjacent Mexico.

O. stanlyi was first found October 22, 1846, by W. H. Emory on his first trip across the continent; he reported the plant as abundant on the Del Norte and Gila. There has been much speculation as to what this species is, for no specimens were preserved. Dr. George Engelmann, who named the species, based it upon a sketch made by the artist of the expedition, Mr. J. M. Stanly. By a reference to Emory's itinerary we find that on October 22, 1846, he was in southwestern New Mexico. In 1908 Dr. Rose visited this region where he collected the various species of cacti to be found there. The only plant which we know from that part of New Mexico which could represent *O. stanlyi* is *Opuntia emoryi;* this was the conclusion reached by Wooton and Standley, who, in their Flora of New Mexico, have restored the name *O. stanlyi.*

We have referred *Opuntia kunzei* here because recent specimens sent in by Dr. Kunze have taken on a phase very much like the true *O. stanlyi.* There is a possibility that *O. kunzei* should be maintained, for we are not altogether convinced that certain material we have seen should be merged into *O. stanlyi.* To clear up this point, it is hoped that someone will collect and preserve a full series of specimens showing flowers, fruits, and seeds.

Illustrations: Emory, Mil. Reconn. App. 2. f. 9; Amer. Garden 11: 531?; Cact. Journ. 1: 154; Cact. Mex. Bound. pl. 70, 71, these last three as *Opuntia emoryi;* Hornaday, Campfires on Desert and Lava opp. p. 116, this as *Opuntia kunzei.*

Plate XIV, figure 3, represents a plant collected by Dr. R. E. Kunze near Gunsight Mountains, Arizona, in 1912; figure 4 shows a leaf-bearing joint of the same plant.

48. **Opuntia schottii** Engelmann, Proc. Amer. Acad. 3: 304. 1856.

Prostrate, rooting from the areoles, forming dense clusters sometimes 2 or 3 meters in diameter; joints clavate, curved, ascending, easily breaking off, 6 to 7 cm. long, 2 cm. in diameter at thickest part, strongly tuberculate; leaves subulate, bronze-colored, 6 to 8 mm. long, acuminate; areoles 1 to 1.5 cm. apart; spines white and sheathed when young, soon brown, the larger ones sometimes as many as 12, very slender, sometimes 6 cm. long, somewhat flattened; wool white when young, turning brown; glochids white when young, turning brown, 4 mm. long or less; flowers yellow, 4 cm. long including ovary; sepals narrow, acuminate; petals acuminate; fruit yellow, narrowly oblong in outline, a little narrowed at base, 4 cm. long, closely set with areoles bearing numerous short spines, bristles, and white wool, the umbilicus depressed; seeds yellow, flattened, 4 mm. in diameter, notched at base.

Type locality: Arid soil near the mouth of the San Pedro and Pecos, western Texas.

Distribution: Southern and western Texas and northern Mexico.

Opuntia schottii greggii Engelmann (Cact. Mex. Bound. 68. pl. 73, f. 4. 1859), which came from near San Luis Potosí, Mexico, where it was collected by Dr. J. Gregg, in December 1848, is much out of the range of the normal form and probably belongs elsewhere; but no specimens have been examined except the type, which is fragmentary. Engelmann at first considered it a distinct species.

Illustration: Cact. Mex. Bound. pl. 73, f. 1 to 3.

Figure 92 represents joints of a plant collected by Dr. Rose at Langtry, Texas, in 1908.

E. E. Eaton del.

1, 2. Parts of joints of *Opuntia exaltata*. 3. Upper part of joint of *Opuntia macrarthra*.
4. Upper part of joint of *Opuntia tortispina*. (All natural size.)

49. **Opuntia clavata** Engelmann in Wislizenus, Mem. Tour North. Mex. 95. 1848.

Plants low, not over 1.5 dm. high, much branched at base, spreading, forming large patches sometimes 2 meters in diameter; joints short, 3 to 7 cm. long, turgid, ascending, clavate; areoles close together; leaves subulate, 4 to 5 mm. long; spines pale, somewhat roughened, the radial ones 6 to 12, slender and acicular, 4 to 16 mm. long; central spines 4 to 7, much longer than the radials, more or less flattened, the largest one dagger-like; glochids numerous, yellowish, 3 to 5 mm. long; flowers yellow, 3.5 to 4 cm. long; fruit 4 to 5 cm. long, with numerous areoles filled with yellow, radiating glochids; seeds white, 5 mm. broad.

Type locality: Albuquerque, New Mexico.

Distribution: New Mexico, chiefly in the central part of the State.

This is one of the most characteristic species of the genus and has no near relative except *O. parishii*, of the deserts of California and Nevada. It is a great pest to grazing stock.

Illustrations: Bull. Agr. Exper. Station N. Mex. 78: pl. [1, 2], Pac. R. Rep. 4: pl. 22, f. 1 to 3; pl. 24, f. 6.

Figure 93 represents joints of a plant collected by W. T. H. Long at Albuquerque, New Mexico, in 1915.

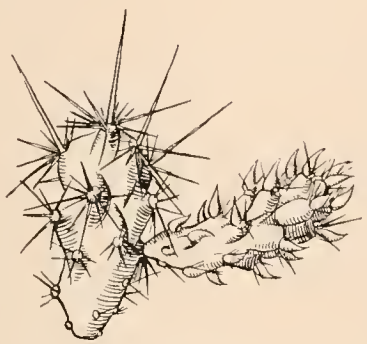


FIG. 92.—Opuntia schottii. ×0 75.

FIG. 93.—Opuntia clavata. ×0.75.

50. **Opuntia parishii** Orcutt, West Amer. Sci. 10: 81. 1896.

Stems low, creeping, rooting along the under surface and forming dense, broad clusters; terminal joints short, clavate, ascending but almost hidden under the dense armament; tubercles prominent but short, 5 to 7 mm. long; spines at first reddish but soon grayish and finally nearly white; radial spines numerous, slender; central spines about 4, strongly angled and more or less flattened, 2 to 4 cm. long; glochids numerous; flowers not known; fruit 5 cm. long, the numerous large areoles bearing many long yellow glochids and short spines forming a radiating band about the margin; seeds dark, 4 mm. broad.

Type locality: Mohave Desert.

Distribution: Southern California and Nevada.

The species here described is the *Opuntia parryi* as described by Engelmann in 1856, although he then suspected it was different from that species. It has been renamed *Opuntia parishii* by Orcutt, who wrote as follows:

"We propose this name for that interesting plant of the Mohave desert region, hitherto called *O. parryi*, and under which it has been well described. The Messrs. Parish have hardly earned this light honor in many laborious trips through these desert regions, and I take pleasure in dedicating this species to them; *Opuntia parryi* (type from San Felipe), along with *bernardina* and *echinocarpa*, and a bewildering host of nameless forms, I unhesitatingly class under *serpentina!*"

Illustrations: Cact. Journ. 1: 132; N. Amer. Fauna 7: pl. 10; Pac. R. Rep. 4: pl. 22, f. 4 to 7; pl. 24, f. 7, all as *Opuntia parryi*.

Figure 94 represents joints of a plant collected by S. B. Parish in southern California.

51. **Opuntia pulchella** Engelmann, Trans. St. Louis Acad. **2**: 201. 1863.

Low, 10 to 20 cm. high, densely branched, sometimes forming compact heads 6 dm. in diameter; main stem more or less definite, covered with areoles bearing yellow glochids 10 to 12 mm. long; lateral joints 5 to 6 cm. long, narrowly clavate, strongly tuberculate, purplish; areoles 6 to 8 mm. apart, 2 to 3 mm. broad; spines 10 to 16, slender, reddish, the longer ones 5 to 6 cm. long, somewhat flattened; flower 5 cm. long, when open, fully as broad; petals purple, 3 cm. long; ovary 2 cm. long, bearing numerous areoles filled with white wool and purple glochids 10 to 12 mm. long; fruit about 2.5 cm. long; seeds (according to Coulter) thick and round, 4 mm. in diameter, with broad flat commissure.

Type locality: Sandy deserts on Walker River, Nevada.

Distribution: Nevada and Arizona.

The plant was first collected by Henry Engelmann in 1859, and brought to his brother, Dr. George Engelmann. The species does not succeed well in cultivation under glass.

Illustration: Simpson's Rep. pl. 3.

Figure 95 is from an herbarium specimen collected by Thomas H. Means at Fallon, Churchill County, Nevada, in 1909.

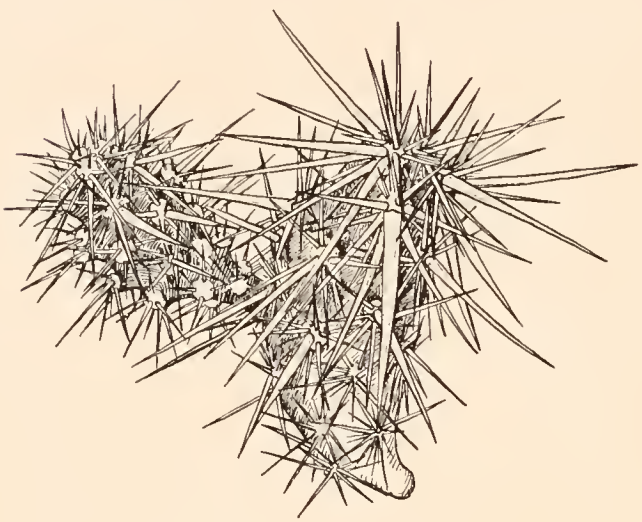


FIG. 94.—Opuntia parishii. ×0.66.

FIG. 95.—Opuntia pulchella ×0.66.

52. **Opuntia vilis** Rose, Contr. U. S. Nat. Herb. **12**: 293. 1909.

Low, creeping, often forming mats several meters in diameter and only 10 to 15 cm. high; joints prostrate, becoming erect or ascending, the ultimate vertical ones clavate, 5 cm. long, the others 2 to 4 cm. long, very turgid, pale green, with low tubercles; leaves terete, 2 to 3 mm. long, acute, red; young areoles bearing white wool; radial spines upward of 12, the number increasing with age by the addition of very small whitish ones; central spines on prostrate joints 4, reddish, white-tipped, 1 to 4 cm. long, terete, slightly scabrous, with a sheath 5 mm. long, those of clavate joints white, reddish on the upper surface at the base, and along the whole of the lower surface flattened; flowers 4 cm. long; petals brilliant purplish, 2 cm. long; filaments bright yellow with green bases; style white; stigma-lobes yellow; fruit pale green, blackening in drying, 2 to 2.5 cm. in diameter, 2.5 to 3 cm. long, tuberculate, especially about the margin of the umbilicus, spiny, fluted above, somewhat dry, with large white seeds.

Type locality: Foot-slopes and plains of Zacatecas, Mexico.

Distribution: State of Zacatecas, Mexico.

Illustrations: Contr. U. S. Nat. Herb. **12**: pl. 27; f. 36.

Figure 96 is from a photograph of the type plant taken by F. E. Lloyd in Zacatecas, Mexico, in 1907.

FIG. 96.—Opuntia vilis.

53. **Opuntia bulbispina** Engelmann, Proc. Amer. Acad. 3: 304. 1856.

Stems low, forming wide-spreading clumps 6 to 12 dm. broad; joints ovoid in outline, 2 to 2.5 cm. long by 10 to 12 mm. in diameter; tubercles prominent, 6 to 8 mm. long; radial spines 8 to 12, acicular, 3 to 6 mm. long; central spines 4, much stouter than the radials, 8 to 12 mm. long, bulbose at base; flower and fruit not described in original description and as yet unknown.

Type locality: Near Perros Bravos, north of Saltillo, Mexico.

Distribution: Coahuila and probably into Durango, Mexico.

The type of this species was collected by Josiah Gregg in 1848 and it has not with certainty been found since; it has been reported from one or two localities, but doubtless erroneously. At one time we supposed certain plants collected by Dr. Palmer in Chihuahua were to be thus referred. It is possible that specimens collected by Dr. Chaffey near Lerdo, Durango, may be referred here, as they have the short joints of this species, but the central spines are much longer, often reaching 2.5 to 3.5 cm. long. The type is deposited in the Engelmann Herbarium at St. Louis, and although the material is poor, it may yet serve to clear up this species definitely.

As stated by Coulter, this species has been regarded as the same as *O. tunicata*, a plant to which it is very remotely related.

Illustration: Cact. Mex. Bound. pl. 73, f. 5, 6.

Figure 97 is copied from the illustration above cited.

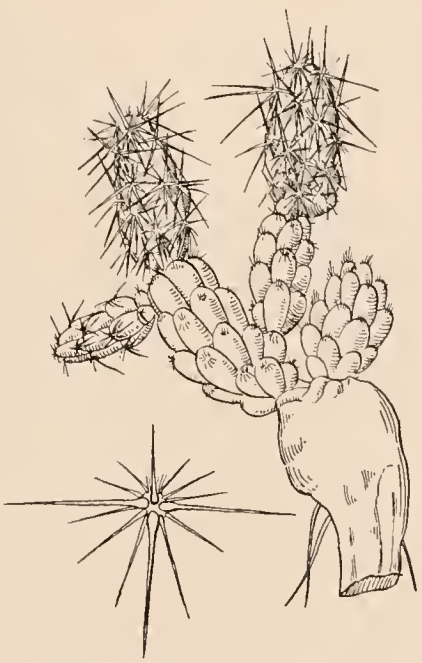


FIG. 97.—Opuntia bulbispina.

54. **Opuntia grahamii** Engelmann, Proc. Amer. Acad. 3: 304. 1856.

Roots at first thick and fleshy, becoming woody, 2 cm. thick or more; plant low, much branched, spreading, forming low mounds often half buried in the sand, sometimes giving off roots at the areoles; terminal joints erect, clavate, bright green, 3 to 5 cm. long, with large oblong tubercles; leaves thick, bronze-colored, ovate, acute, 3 to 4 mm. long; areoles about 3 mm. broad; wool white; spines 8 to 15, slender, slightly scabrous, terete or some of the larger ones slightly compressed, white when young, soon reddish, the longest 3.5 to 6 cm. long; glochids numerous, slender, 4 mm. long or less,

white, turning brown, persistent on the old stems; flowers yellow, 5 cm. broad; sepals ovate, acute, about 5 mm. long; fruit oblong to ovoid, 3 to 4.5 cm. long, its numerous areoles bearing white glochids and some slender spines; seeds beakless, 5 to 5.5 mm. in diameter, the commissure indistinct, linear.

Type locality: Near El Paso, Texas.

Distribution: Western Texas, New Mexico, and adjacent parts of Mexico.

This species was named for James Duncan Graham, Colonel, Corps of Engineers, United States Army, who died December 28, 1865, at Boston, Massachusetts. Colonel Graham was for a time chief of the scientific corps of the United States and Mexican Boundary Commission, and caused the specimens of this plant to be transmitted to Dr. George Engelmann.

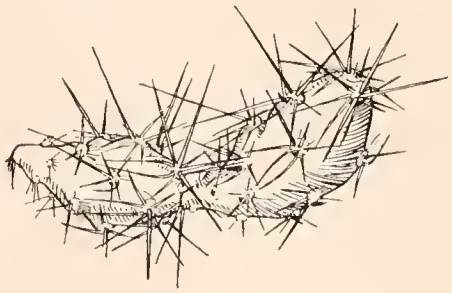


FIG. 98.—Opuntia grahamii. ×0.75.

The plant succeeds rather well in cultivation under glass.

Illustrations: Cact. Mex. Bound. pl. 72; Schumann, Gesamtb. Kakteen f. 102.

Figure 98 represents joints of a plant collected by Dr. Rose on hills near Sierra Blanca, Texas, in 1913.

Subgenus 2. TEPHROCACTUS.

Includes all the South American species of *Opuntia* which have short, oblong, or globular joints. It is hardly to be distinguished from the North American series *Clavatae*. Four series are recognized. The plants are confined to Peru, Chile, Bolivia, and Argentina. (See key to series, p. 44.)

Series 1. WEBERIANAE.

Plants low, forming dense clumps; joints subcylindric, strongly tuberculate and bearing numerous spines. This series suggests *Platyopuntia*, while the other series show closer relationship with the *Cylindropuntia*. Only one species known, inhabiting the dry part of northern Argentina.

55. Opuntia weberi Spegazzini, Anal. Mus. Nac. Buenos Aires III. 4: 509. 1905.

Densely cespitose, forming clumps 2 to 3 dm. in diameter and 10 to 18 cm. high; joints yellowish green, erect, cylindric, strongly tuberculate, 2 to 6 cm. long, 1.5 to 2 cm. in diameter, densely spiny;

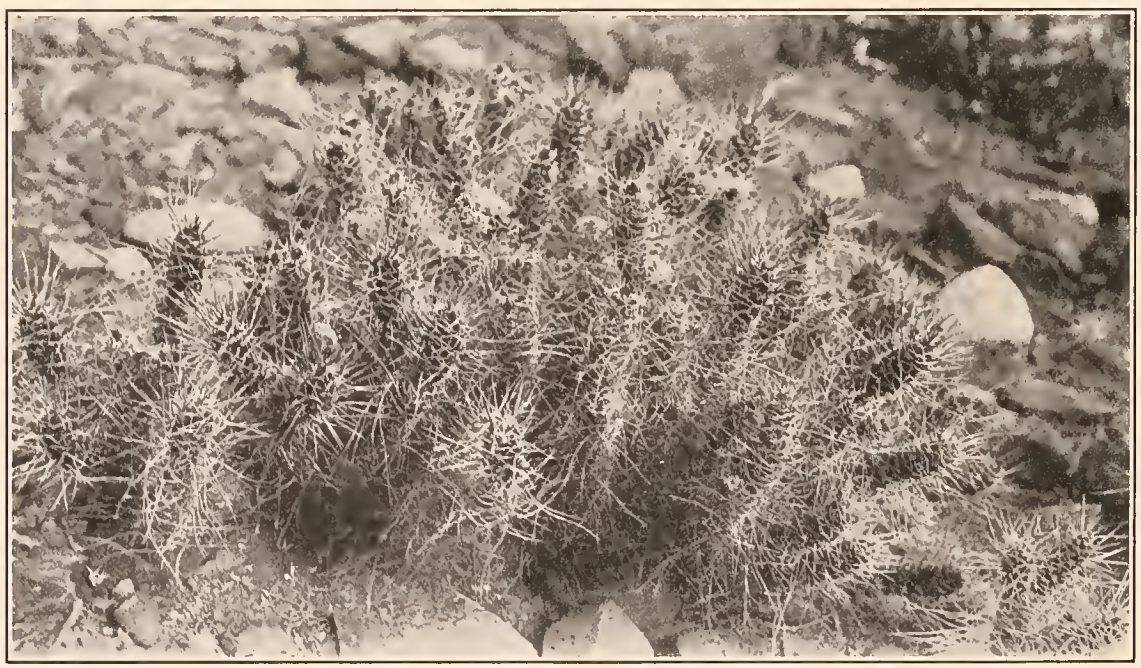


FIG. 99.—Opuntia weberi as it grows wild.

leaves described as wanting; tubercles spirally arranged, obtuse, somewhat 4-angled, 5 to 6 mm. broad; areoles somewhat depressed; spines 5 to 7, brown, 3 to 5 cm. long, flexuous, the upper ones erect; flowers borne near the top of the plant, small, solitary; ovary somewhat woolly below and with short spines above; flower rotate, yellow; fruit dry, white, 10 mm. in diameter; seeds somewhat contorted, bony, glabrous.

Type locality: In Sierra Pie de Palo, Province of San Juan, Argentina.

Distribution: Mountains of Provinces of San Juan and Salta, Argentina.

This description, though largely drawn from Dr. Spegazzini's full account of this species, has been amplified from examination made of the type. Dr. Spegazzini refers it

FIG. 100.—Opuntia weberi. Natural size.

to the subgenus *Tephrocactus*, and we have followed him in this; but it differs widely from any other known species of that group and its true affinity may be elsewhere. If the plant is leafless, as Dr. Spegazzini's description implies, this is a most interesting exception to the character of *Opuntia*.

Figure 99 is from a photograph of the plant at Molinos, Argentina; figure 100 is from a photograph of the type specimen in the collection of Dr. Spegazzini, to whom we are indebted for both of these illustrations.

Series 2. FLOCCOSAE.

Low plants, forming dense clumps or mounds; joints short, thick, and fleshy, usually covered with long, white, silky hairs. The two species are common in the high valleys of the Andes of Peru and Bolivia.

KEY TO SPECIES.

Spines yellow, stout ..... 56. *O. floccosa*
Spines white, acicular ..... 57. *O. lagopus*

56. Opuntia floccosa Salm-Dyck, Allg. Gartenz. **13**: 388. 1845.

Opuntia senilis Roezl in Morren, Belg. Hort. **24**: 39. 1874.
Opuntia floccosa denudata Weber, Dict. Hort. Bois 897. 1898.
Opuntia hempeliana Schumann, Gesamtb. Kakteen 690. 1898.

Plant growing in clumps or low mounds sometimes 1 to 2 meters in diameter, with hundreds of short, erect branches; joints oblong, 5 to 10 cm. long, usually hidden under a mass of long white hairs coming from the areoles; spines usually one from an areole, sometimes as many as three, yellow, 1 to 3 cm. long; leaves minute, green or pinkish; tubercles somewhat elevated, elongated; flowers, small, 3 cm. long, yellow; fruit globular, 3 cm. in diameter: seeds 4 mm. in diameter, with very narrow margins.

FIG. 101.—Opuntia floccosa.

Type locality: Said to be from vicinity of Lima, Peru, but doubtless only from the high mountains east of Lima.

Distribution: High mountain valleys and hills of the Andes from central Peru to central Bolivia.

O. floccosa is one of the most unusual and striking species of all the opuntias. One who is familiar only with the opuntias of North America would not suspect that it belongs to the genus. It does not grow on the hot mesas in the low country, as one would expect, but in the high, cold valleys and hills near the top of the Andes. The following paragraph, taken from John Ball's notes, is interesting in this connection:

> Reserving some remarks on the botany of this excursion, there is yet to be mentioned here one plant of the upper region so singular that it must attract the notice of every traveler. As we ascended from Casapalta we noticed patches of white, which from a distance looked like snow. Seen nearer

at hand, they had the appearance of large, rounded, flattened cushions, some five or six feet in diameter, and a foot high, covered with dense masses of floss silk that glistened with a silvery lustre. The unwary stranger who should be tempted to use one of these for a seat would suffer from the experiment. The plant is of the cactus family, and the silky covering conceals a host of long, slender, needle-like spines, that penetrate the flesh, easily break, and are most difficult to extract. Unfortunately, the living specimen which I sent to Kew did not survive the journey.

Dr. Rose found the plant very abundant in the Andes from 3,600 to 4,260 meters altitude, while others have reported it as high as 4,570 meters altitude. It is very common, forming everywhere great, conspicuous, usually white mounds. Dr. Rose also found it quite common between Cuzco and Juliaca, in southwestern Peru.

Mr. O. F. Cook, in the Journal of Heredity (8: 113. 1917), who has named this plant the polar bear cactus, wrote of it as follows:

> Many exposed slopes on the bleak plateaus of the high Andes are dotted with clumps of pure white cacti that look from a distance like small masses of snow. On closer view, the shaggy white hair of these cacti make them appear like small sheep or poodle-dogs, or like reduced caricatures of the denizens of the arctic regions. We are so accustomed to think of cacti primarily as desert plants, peculiarly adapted to hot, dry deserts, that they seem distinctly out of place on the cold plateaus of the high Andes of southern Peru.

While most of the plants are covered with long white hairs, plants without hairs are not uncommon. These naked plants, which are characteristic of the whole clump or colony, appear at first sight very unlike the other forms, but they grow in the same region and have the same kind of flowers and fruits. In cultivated plants few hairs are developed. The variety *denudata* Weber seems to be only one of these naked forms.

Opuntia involuta Otto (Förster, Handb. Cact. 505. 1846) was not published, but was given as a synonym of this species. It was used the year before (Salm-Dyck, Allg. Gartenz. 13: 388. 1845) as a synonym of *O. vestita*.

Illustrations: Engler and Drude, Veg. Erde 12: pl. 14; Monatsschr. Kakteenk. 11: 41, 44, these last two as *Opuntia hempeliana;* Journ. Heredity 8: f. 3 to 8.

Plate XIII, figure 2, is from a photograph taken by Mr. O. F. Cook in the high mountains of eastern Peru. Figure 101 is from a photograph of a fragment of the plant collected by Dr. Rose in 1914, at Araranca, Peru.

57. **Opuntia lagopus** Schumann, Gesamtb. Kakteen Nachtr. 151. 1903.

Plants cespitose, growing in compact mounds; joints stout, cylindric, 10 cm. long, 3 to 3.5 cm. in diameter, densely covered with long white hairs; leaves minute, hidden under the wool, 7 mm. long; spines solitary, white, 2 cm. long, slender; glochids white, bristle-like; flowers probably red; fruit not known.

Type locality: Mountains of Bolivia above Arequipa, Peru.

Distribution: On the plains of the high Andes of Peru and Bolivia (altitude 4,000 meters).

This species is related to *O. floccosa*, with which it often grows, but it takes on a very different habit, growing in very dense, peculiar rounded mounds much higher than those formed by *O. floccosa*.

Illustration: Engler and Drude, Veg. Erde 12: pl. 14.

Figure 102 is from a photograph by H. L. Tucker, near Laxsa, Peru, in 1911.

Series 3. GLOMERATAE.

Plants low, composed of globose or oblong joints, the spines, or some of them, modified into flat papery processes. We recognize two species, confined to western Argentina.

Key to Species.

Central spines papery; radial spines subulate ..... 58. *O. australis*
Spines, when present, all developed into long papery processes ..... 59. *O. glomerata*

FIG. 102.—Opuntia lagopus, growing in a mound.

58. Opuntia australis Weber, Diet. Hort. Bois 896. 1898.

Pterocactus valentinii Spegazzini, Anal. Soc. Cient. Argentina 48: 51. 1899.

Plants often with large roots, these 5 to 8 cm. long by 2 to 3 cm. in diameter and larger than the parts above ground; joints described as cucumber-shaped, usually 6 to 8 cm. long by 1 to 2 cm. in diameter, but apparently often much smaller, tuberculate; radial spines 10 to 15, spreading, white, short, 3 to 4 cm. long; central spines 1 or 2, much longer than the radials, 2 cm. long, erect, flattened, and somewhat papery; flowers yellow, 2 to 3 cm. broad; seeds said to be rugose.

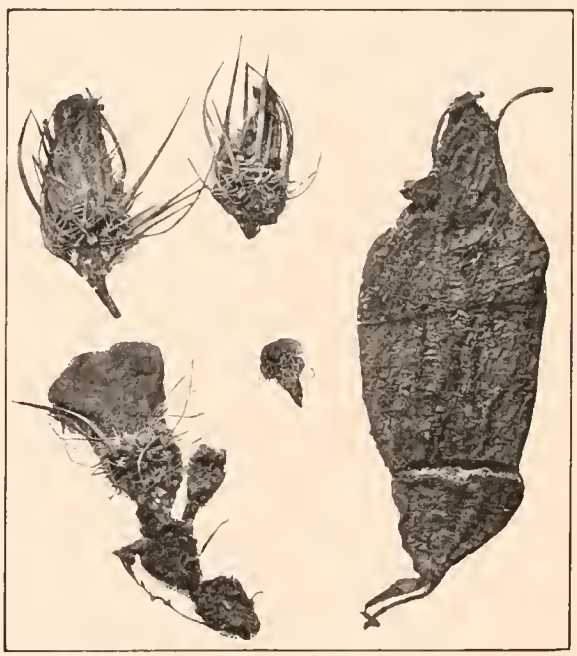


FIG. 103.—Opuntia australis. Showing large roots, joints, and flower. Natural size.

Type locality: Between Santa Cruz River and the Strait of Magellan, Argentina.

Distribution: The southernmost parts of Argentina.

We have recently examined three collections of this plant made by Carl Skottsberg in the Territory of Santa Cruz, which in the main agree with Weber's description. We have also seen *Pterocactus valentinii*, which is the same as Skottsberg's plant.

Dr. Spegazzini records this species as being in Santa Cruz, Argentina; but as he regards the plant collected there by him as only a variety of *O. darwinii*, we are inclined to believe he must have collected something else.

This species, which is found at the Strait of Magellan, extends farther south than any other cactus known to us.

Figure 103 is from a photograph of an herbarium specimen collected by Carl Skottsberg in the Territory of Santa Cruz, Patagonia, in 1908.

59. Opuntia glomerata Haworth, Phil. Mag. 7: 111. 1830.

Opuntia articulata Otto, Allg. Gartenz. 1: 116. 1833.
Cereus articulatus Pfeiffer, Enum. Cact. 103. 1837.
Cereus syringacanthus Pfeiffer, Enum. Cact. 103. 1837.
Opuntia platyacantha Salm-Dyck in Pfeiffer, Allg. Gartenz. 5: 371. 1837.
Opuntia tuberosa spinosa Pfeiffer, Enum. Cact. 146. 1837.
Opuntia andicola Pfeiffer, Enum. Cact. 145. 1837.
Opuntia diademata Lemaire, Cact. Aliq. Nov. 36. 1838.
Opuntia turpinii Lemaire, Cact. Aliq. Nov. 36. 1838.
Opuntia andicola elongata Lemaire, Cact. Gen. Nov. Sp. 72. 1839.
Opuntia andicola fulvispina Lemaire, Cact. Gen. Nov. Sp. 72. 1839.
Opuntia andicola major Lemaire, Cact. Gen. Nov. Sp. 72. 1839.
Opuntia calva Lemaire, Cact. Gen. Nov. Sp. 73. 1839.
Opuntia platyacantha gracilior Salm-Dyck, Cact. Hort. Dyck. 1844. 43. 1845.
Opuntia platyacantha monvillei Salm-Dyck, Cact. Hort Dyck. 1849. 71. 1850.
Opuntia platyacantha deflexispina Salm-Dyck, Cact. Hort. Dyck. 1849 245. 1850.
Opuntia papyracantha Philippi, Gartenflora 21: 129. 1872.
Opuntia syringacantha Schumann, Monatsschr. Kakteenk. 6: 156. 1896.
Opuntia plumosa nivea Walton, Cact. Journ. 1: 105. 1898.

Forming low, spreading clumps, the branches either erect or prostrate; joints globular, 3 to 6 cm. in diameter, often in cultivated specimens even smaller, dull grayish brown, hardly tuberculate except in drying; areoles large, bearing numerous long, brown glochids; spines often wanting, when present 1 to 3, long, weak, thin and papery, hardly pungent, either white or brownish, sometimes 10 cm. long; flowers light yellow, small; fruit globose, 1 to 1.5 cm. long, dry; seeds corky.

Type locality: Brazil, according to Haworth, but erroneously.

Distribution: Western Argentina. It has also been referred to Brazil and Chile, but surely not found in Brazil, and we should not expect it to inhabit Chile.

The plant figured by Nicholson (Dict. Gard. 2: f. 755) as *O. platyacantha* hardly belongs here.

O. glomerata, which is common on the dry hills about Mendoza, is very variable, especially as to whether it is spine-bearing or not; while the spines—which are really not spines but thin ribbon-like processes—vary much as to their color, markings, and length. These variations are partly the cause of so many synonyms for the species. Dr. Rose, who visited the region in which this species grows, found wide variation in the size of the joints, as well as in the absence or presence of spines.

Fig. 104.—Opuntia glomerata. ×0.5.

Tephrocactus diadematus Lemaire (Cact. 88. 1868), *T. turpinii* Lemaire (Cact. 88. 1868), *Opuntia polymorpha* Pfeiffer (Enum. Cact. 103. 1837), and *Opuntia turpinii polymorpha* Salm-Dyck (Cact. Hort. Dyck. 1849. 71. 1850) are usually given as synonyms of *Opuntia diademata*, but none of them was actually published. *Opuntia polymorpha* Pfeiffer was used by Pfeiffer as a synonym for *Cereus articulatus* Pfeiffer.

Tephrocactus andicolus, *T. calvus*, and *T. platyacanthus*, all of Lemaire (Cact. 88. 1868), without descriptions, are referred here by inference.

Spegazzini (Anal. Mus. Nac. Buenos Aires III. 4: 511. 1905) describes three varieties of this species under *O. diademata*, from Argentina, as follows: *inermis*, *oligacantha*, and *polyacantha;* while Weber (Dict. Hort. Bois 896. 1898) under the same name describes var. *calva*, but these all seem to be forms of this very variable species.

The following varietal names, under *Opuntia glomerata* var. *albispina* Förster (Handb. Cact. 472. 1846), var. *flavispina* Salm-Dyck (Cact. Hort. Dyck. 1844. 43. 1845), and var. *minor* Salm-Dyck (Cact. Hort. Dyck. 1849. 71. 1850), are mentioned in the places cited, but not described.

Opuntia horizontalis Gillies (Pfeiffer, Enum. Cact. 145. 1837) was used as a synonym of *Opuntia andicola*, and should be referred here.

Opuntia pelaguensis (Salm-Dyck, Cact. Hort. Dyck. 1849. 71. 1850) was published as a synonym of *Opuntia platyacantha deflexispina*.

Opuntia andicola minor, an unpublished variety, is mentioned by name only in Monatsschrift für Kakteenkunde (10: 48. 1900).

Illustrations: Cact. Journ. 1: 100, as *Opuntia andicola:* Engler and Prantl, Pflanzenfam. 3^{6a}: f. 56, K.; Gard. Chron. III. 34: f. 39; Monatsschr. Kakteenk. 13: 23, these three as *Opuntia diademata*. Cact. Journ. 1: February; Dict. Gard. Nicholson Suppl. f. 607; Förster, Handb. Cact. ed. 2. f. 125; Gard. Chron. III. 23: f. 129; 29: f. 63; Gartenflora 21: pl. 721, f. 2, all as *Opuntia papyracantha*; Cact. Journ. 1: 105, as *Opuntia plumosa nivea*.

Figure 104 represents a plant collected by Dr. Rose at Mendoza, Argentina, in 1915.

Opuntia schumannii Spegazzini (Anal. Mus. Nac. Buenos Aires III. 4: 511. 1905, not Berger, 1904) is a homonym, and we hesitate to give it a new name until it is better known. The type comes from Salta, Argentina, from a region where we already have a number of species of *Tephrocactus*. Spegazzini, who described it, says it is related to *O. diademata*, which is now referred to *O. glomerata*, but is very distinct. It is without spines and the flowers are unknown.

Series 4. PENTLANDIANAE.

Plants often growing in large mounds; joints globular to oblong; spines usually slender, acicular to subulate. Seventeen species are here recognized.

Key to Species.

- Spines very long and stout, up to 15 to 20 cm. long ... 60. *O. aoracantha*
- Spines slender, 10 cm. long or less.
  - Spines appressed to the joints.
    - Spines 12 to 20, flexuous; joints 7 cm. long ... 61. *O. rauppiana*
    - Spines 6 or 7; joints 2 to 4 cm. long ... 62. *O. subterranea*
  - Spines straight, not appressed.
    - Spines flat or semiterete.
      - Spines 7 to 10 cm. long ... 63. *O. hickenii*
      - Spines 6 cm. long or less.
        - Longer spines 1 to 3.
          - Joints ellipsoid, 4 to 5 cm. thick ... 64. *O. darwinii*
          - Joints oblong, 1 cm thick ... 65. *O. tarapacana*
        - Longer spines 4 or 5.
          - Spines gray ... 66. *O. atacamensis*
          - Spines yellow ... 67. *O. russellii*
    - Spines terete.
      - Spines white, at least when young.
        - Joints tuberculate ... 68. *O. corrugata*
        - Joints not tuberculate.
          - Joints oblong ... 69. *O. ovata*
          - Joints globose ... 70. *O. sphaerica*
      - Spines yellow to brown or nearly black.
        - Roots large and woody; spines nearly black ... 71. *O. skottsbergii*
        - Roots fibrous.
          - Spines purple-black ... 72. *O. nigrispina*
          - Spines yellow to brown.
            - Plants forming large clumps.
              - Fruit about 2.5 cm. long, nearly unarmed ... 73. *O. pentlandii*
              - Fruit 5 to 6 cm. long, copiously armed with long spines above ... 74. *O. ignescens*
            - Plants isolated, not forming clumps.
              - Old joints globose; spines acicular ... 75. *O. campestris*
              - Joints all oblong; spines subulate ... 76. *O. ignota*

60. Opuntia aoracantha Lemaire, Cact. Aliq. Nov. 34. 1838.

Cereus ovatus Pfeiffer, Enum. Cact. 102. 1837. Not *Opuntia ovata* Pfeiffer, l. c. 144. 1837.
Opuntia formidabilis Walton, Cact. Journ. 1: 105. 1898.

Usually low, cespitose, forming clumps 2 to 5 dm. in diameter and sometimes 1 to 2 dm. high; branches grayish, either erect or prostrate, made up of 5 to 10, perhaps even more, globular joints; joints easily detached, freely rooting and starting new colonies, 5 to 8 cm. in diameter, strongly tuberculate especially when young, the lower part spineless, the upper areoles large, spine-bearing; spines brown or blackish, 1 to 7, the longer ones 13 cm. long, straight, a little flattened, roughish to the touch; flowers white; fruit short-oblong, 3 cm. long, red, weakly tuberculate, bearing numerous areoles, usually naked but sometimes bearing a few short spines near the top, becoming dry; umbilicus of fruit broad and depressed; seeds white, flattened, 4 to 5 mm. broad, the margins thick and corky.

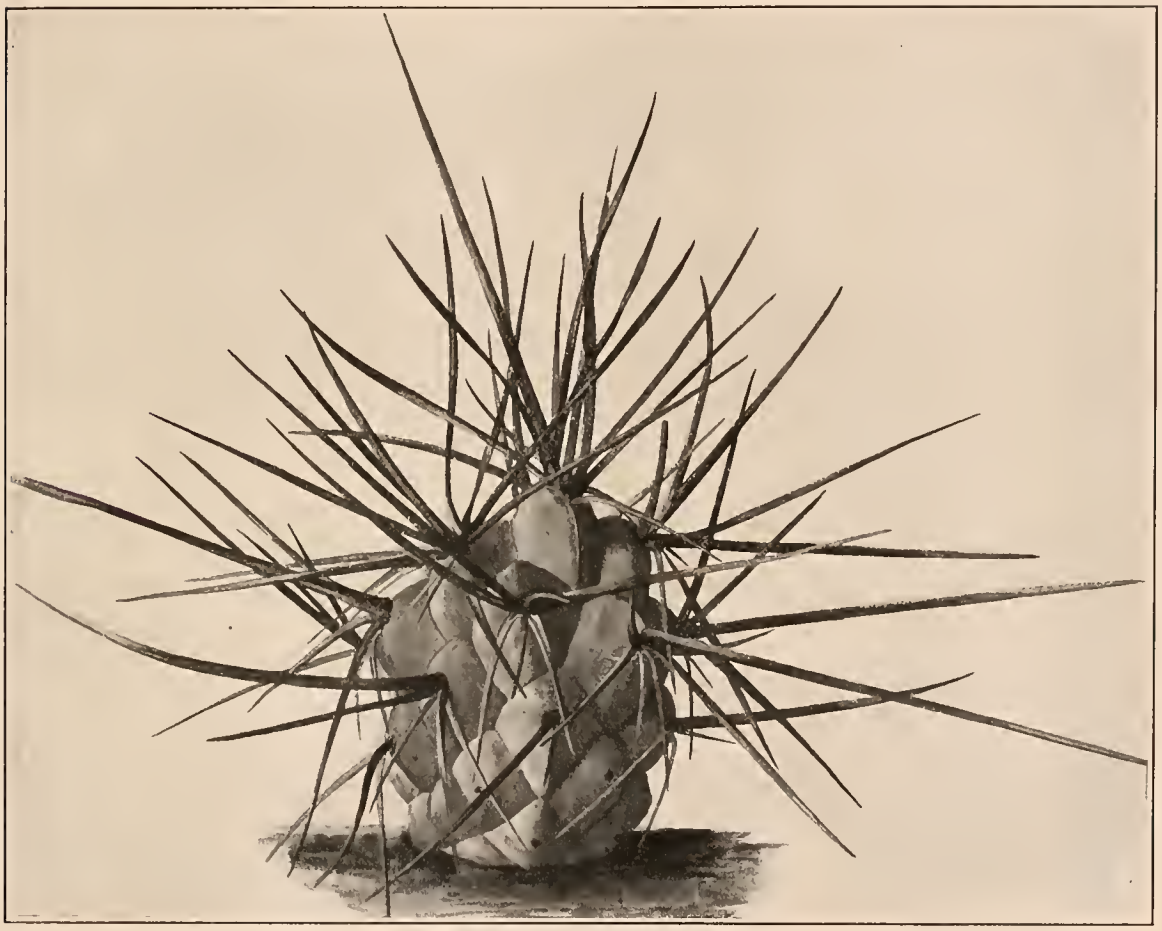


FIG. 105.—Opuntia aoracantha. ×0.66.

Type locality: Not cited, but doubtless from Mendoza.

Distribution: Western provinces of Argentina, from Mendoza to Jujuy.

Opuntia gilliesii Pfeiffer (Enum. Cact. 102. 1837, as synonym) and *Tephrocactus aoracanthus* Lemaire (Cact. 89. 1868) are usually given as synonyms of this species, but they were not described in the places usually cited, and as here given. *Opuntia acracantha* Walpers (Repert. Bot. 2: 354. 1843) is a typographical error.

O. aoracantha, although described nearly 80 years ago, is practically unknown in collections and has been very poorly described. The fruit has heretofore been unknown. Dr. Rose found it in 1915 in great abundance growing on dry, rocky hills west of Mendoza,

although in but one locality. A bountiful supply of living material was sent home, several photographs were taken, and fruit and seeds obtained.

Opuntia tuberiformis Philippi (Anal. Mus. Nac. Chile 1891[2]: 28. 1891), referred here by Schumann, doubtless belongs elsewhere. It may possibly belong to some *Platyopuntia*, for it is described as having ovate joints only 5 mm. thick. It comes from the foot of the Andes in the Province of Tarapaca, Chile.

Illustrations: Gard. Chron. III. 34: f. 40; Monatsschr. Kakteenk. 12: 172; Cact. Journ. 1: 105, the last as *O. formidabilis*.

Figure 105 represents a joint of a plant collected by Dr. Rose at Mendoza, Argentina, in 1915.

61. **Opuntia rauppiana** Schumann, Monatsschr. Kakteenk. 9: 118. 1899.

Joints ellipsoid, rounded at each end, somewhat tuberculate, dark green or becoming grayish green, 7 cm. long by 4 cm. in greatest diameter; glochids yellow, 5 cm. long; spines 12 to 14, sometimes as many as 20, very weak, almost bristle-like, 2 cm. long, hardly pungent.

Fig. 106.—Opuntia rauppiana.

Type locality: In the Andes.

Distribution: Bolivia, according to Schumann.

Little is known of the habit of this plant, as only one joint is figured and this appears to be a sickly greenhouse specimen. It suggests some of the species which grow in large clumps like the one figured as *Opuntia grata* by Fries.

Illustrations: Monatsschr. Kakteenk. 9: 118; Schumann, Gesamtb. Kakteen Nachtr. f. 36 (same).

Figure 106 is copied from the illustration above cited.

62. **Opuntia subterranea** R. E. Fries, Nov. Act. Soc. Sci. Upsal. IV. 1[1]: 122. 1905.

Almost buried in the sand, simple or few-branched from a thick root 7 to 12 cm. deep: joints terete, 2 to 4 cm. long; tubercles low; spines 1 to 7, all radial, short, whitish, recurved, appressed;

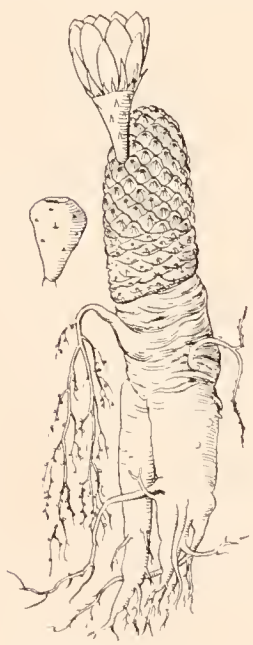


Fig. 107.—Opuntia subterranea

Fig. 108.—Opuntia hickenii. X0.6.

flowers lateral, brownish; ovary small, with a depressed umbilicus, its areoles bearing small glochids and a little wool; fruit 12 to 15 mm. long; seeds 3 mm. broad, irregular.

Type locality: Near Moreno, Jujuy, Argentina.

Distribution: Northern Argentina and adjacent Bolivia.

This peculiar little plant, heretofore known only from the type collection, was obtained by Dr. Shafer on stony plains at Villazón, Bolivia, in February 1917, but was not in bloom.

Illustration: Nov. Act. Soc. Sci. Upsal. IV. 1[1]: pl. 8, f. 4 to 8.

Figure 107 is copied from the illustration above cited.

63. **Opuntia hickenii** sp. nov.

Low, cespitose, forming clusters 1 meter in diameter; joints globular, 3 to 5 cm. in diameter, strongly tuberculate, the lower tubercles usually spineless; areoles rather large, circular; spines 2 to 5, flat and thin, narrow, weak, pungent, 5 to 12 cm. long, silvery-colored but nearly black in age; flowers yellow; fruit not known.

Type in United States National Herbarium, No. 603229, from Puerto Madryn, Chubut, Argentina, collected by Cristóbal M. Hicken.

Common in Chubut and Rio Negro, southern Argentina, where it was collected several times by Dr. Hicken.

Figure 108 represents the type specimen above cited.

A photograph of a plant from San Juan, Argentina, communicated by Dr. Spegazzini, indicates another species of this relationship.

64. **Opuntia darwinii** Henslow, Mag. Zool. Bot. 1: 466. 1837.

Low, perhaps not more than 2 to 4 cm. high, much branched at base from a more or less elongated woody root; joints normally few, nearly globular, about 3 cm. in diameter, or often nearly cylindric, frequently numerous and small and growing out from the main axis, then only 5 to 10 mm. in diameter; areoles large, filled with wool, the lower ones spineless; spines 1 to 3, nearly erect, the longest one 3 to 3.5 cm. long, yellow or reddish yellow, decidedly flattened; flowers originally described as larger than the joints, but certainly often much smaller; petals yellow, broad, with a truncate or depressed top and usually with a mucronate tip; ovary, in specimens seen, only 2 cm. long, covered with large woolly areoles; styles described as stout, with 9 thick radiating stigma-lobes.

Type locality: Port Desire, Patagonia, latitude 47° south.

Distribution: Southern Argentina.

This species seems to be common in that part of Patagonia known now as the Territory of Santa Cruz, Argentina. We have recently examined four separate collections made in this region, especially one from about Lake Buenos Aires and on the Fenix River by Carl Skottsberg, in 1907–1909.

The plant is in cultivation in Europe and is offered for sale by cactus dealers.

It was first collected by Charles Darwin, but only a single joint was taken, which was described and figured by Rev. J. S. Henslow. The illustration of the flowers seems too large, but otherwise represents fairly well the plant as we know it. The following interesting note is taken from Mr. Henslow's article as it appeared in the Magazine of Zoology and Botany, volume 1, page 467:

I have named this interesting Cactus after my friend C. Darwin, Esq., who has recently returned to England, after a five years' absence on board H. M. S. *Beagle*, whilst she was employed in surveying the southernmost parts of South America. The specimen figured was gathered in the month of January, at Port Desire, lat. 47° S. in Patagonia. He recollects also to have seen the same plant in flower as far south as Port St. Julian in lat. 49° S. It is a small species growing close to the ground on arid gravelly plains, at no great distance from the sea. The flowers had one day arrested his attention by the great irritability which their stamens manifested upon his inserting a piece of straw into the tube, when they immediately collapsed round the pistil, and the segments of the perianth soon after closed also. He had intended to procure fresh specimens on the following day, and returned to the ship with the one now figured, but unfortunately she sailed immediately afterwards, and he was prevented from obtaining any more. The geographical position of this

species is beyond the limits hitherto assigned to any of the order, which are not recorded as growing much south of the tropic of Capricorn. The climate is remarkably dry and clear, hot in summer, but with sharp frosts during the winter nights. He found Cacti both abundant and of a large size, a little farther to the north at Rio-Negro in latitude 41° S.

Illustration: Mag. Zool. Bot. 1: pl. 14, f. 1.

Figure 109 is copied from a photograph of an herbarium specimen collected by Carl Skottsberg in Patagonia in 1908.

65. **Opuntia tarapacana** Philippi, Anal. Mus. Nac. Chile 1891[2]: 27. 1891.

Opuntia rahmeri Philippi, Anal. Mus. Nac. Chile 1891[2]: 27. 1891.

Low, cespitose plants; joints small, ovoid, about 2 cm. long by 1 cm. thick, bearing spines from white woolly areoles at tips; spines usually 3, straight, 12 to 15 mm. long, white with yellowish tips; flowers yellow; petals 21 mm. long; ovary elongated, 2 cm. long.

Type locality: Calalaste, Chile.

Distribution: Known only from type locality, although Schumann in his Keys refers this species to Bolivia.

Although the type of this species is preserved in the Museum at Santiago, Chile, it is insufficient to enable us to give a very full description. It seems distinct from the other species of the group.

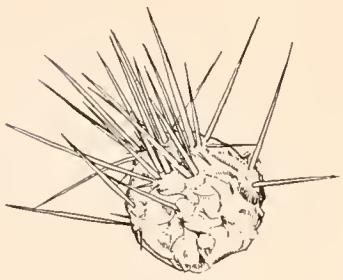


FIG. 109.—O. darwinii. ×0.6.

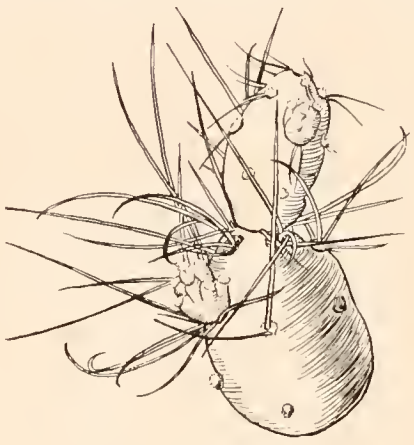


FIG. 110.—O. ataeamensis. ×0.6.

FIG. 111.—O. russellii. ×0.6.

66. **Opuntia atacamensis** Philippi, Fl. Atac. 24. 1860.

? *Pereskia glomerata* Pfeiffer, Enum. Cact. 179. 1837. Not *Opuntia glomerata* Haworth. 1830.

Growing in large, dense clusters sometimes 6 dm. broad and 3 dm. high; joints ovoid, 2.5 cm. long by 2 cm. in diameter; areoles in 5 to 7 series, the lower ones with wool and very short spines; upper areoles each bearing 1 erect central spine 18 to 25 mm. long, yellow or reddish; radial spines 2 to 4, strongly appressed, 2 mm. long; flowers yellow.

Type locality: Profetas, Chile; also Puquios, 23° 50′ south latitude.

Distribution: On the high central deserts of northern Chile at an altitude of 2,700 to 3,300 meters.

We have not seen the type of this species, and our reference of *Pereskia glomerata* here may not be correct.

Illustration: Nov. Act. Soc. Sct. Upsal. IV. 1[1]: pl. 1, as *Opuntia grata.*

Figure 110 represents a plant obtained by Dr. Rose at the Botanical Garden, Santiago, Chile, in 1914.

67. **Opuntia russellii** sp. nov.

Forming small, compact clumps 1 to 2 dm. in diameter; joints small, globular to obovoid, dull green to more or less purplish, 2 to 4 cm. long, very spiny near the top; leaves minute, acute, soon falling; prominent spines 3 to 6, yellow, 2 to 3 cm. long, slightly flattened; accessory spines 1 to

several, 1 cm. long or less; glochids at first inconspicuous, but in time very abundant, sometimes 2 cm. long, somewhat persistent; flowers not known; fruit globular, 2 to 2.5 cm. in diameter, spineless; seeds pale, 4 mm. broad.

Collected by J. N. Rose and Paul G. Russell on the dry hills at Potrerillos, Mendoza, Argentina, September 2, 1915 (No. 21002).

This is a common species in the foothills of the Andes, in the Province of Mendoza, where it forms low mounds along with other cacti.

Figure 111 represents joints of the type specimen above cited.

68. Opuntia corrugata Salm-Dyck, Hort. Dyck. 360. 1834.

Opuntia eburnea Lemaire, Cact. Aliq. Nov. 35. 1838.
Opuntia retrospinosa Lemaire, Cact. Aliq. Nov. 35. 1838.
Opuntia parmentieri Pfeiffer, Allg. Gartenz. 6: 276. 1838.

More or less cespitose; joints 3.5 cm. long, 8 to 12 mm. in diameter, orbicular to cylindric, often erect, attenuate at both ends, light green, the terminal one often flattened; glochids minute, yellowish; spines 6 to 8, acicular, 8 to 12 mm. long, white; flowers reddish; fruit red.

Type locality: None given.

Distribution: Northwestern Argentina, according to later writers.

Lemaire (Cact. 88. 1868) uses the names *Cactus corrugatus* and *C. eburneus*, both of which Schumann refers here.

Tephrocactus retrospinosus Lemaire (Cact. 88. 1868) is placed by Lemaire in his third section of *Tephrocactus*, but it is without description. It is doubtless the same as *Opuntia retrospinosa* Lemaire, which belongs here.

Opuntia aulacothele Weber (Gosselin, Bull. Mus. Hist. Nat. Paris 10: 392. 1904), which was described without flowers or fruit, may be of this alliance. It comes from San Rafael, Argentina.

Opuntia cornigata, mentioned in Bailey's Standard Cyclopedia of Horticulture (4: 2367. 1916), is a misspelling of this name.

Opuntia corrugata monvillei Salm-Dyck (Cact. Hort. Dyck. 1849. 72. 1850) was not described.

Opuntia longispina Haworth (Phil. Mag. 7: 111. 1830), when first described, was supposed to have come from Brazil; the Index Kewensis refers it to Chile; while Schumann treats it in a note under *O. corrugata* as an Argentine species. It may not be an *Opuntia* but a *Maihuenia*.

69. Opuntia ovata Pfeiffer, Enum. Cact. 144. 1837.

Opuntia ovallei Remy in Gay, Fl. Chilena 3: 29. 1847.
Opuntia grata Philippi, Linnaea 30: 211. 1859.
Opuntia monticola Philippi, Linnaea 33: 82. 1864.

Low, branching, cespitose plants; joints yellowish green, some deep purple when young, subcylindric to ellipsoid, 3 cm. long; spines 5 to 9, 4 to 10 mm. long, when young brownish, in age white; fruit ovoid; umbilicus curved outward.

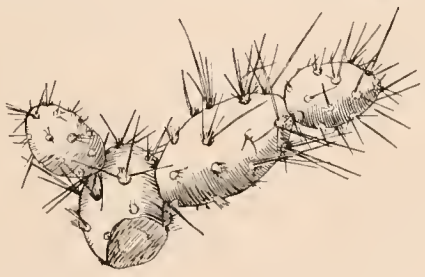


FIG. 112.—Opuntia ovata. ×0.5.

Type locality: Mendoza, Argentina.

Distribution: Mountains of Argentina and Chile.

Opuntia ovoides Lemaire (Cact. Gen. Nov. Sp. 73. 1839) and *Cactus ovoides* Lemaire (Cact. 88. 1868) are usually cited as synonyms for *Opuntia ovata;* they are unpublished names.

This species forms low clumps, each branch consisting of 2 to 5 joints. Dr. Rose found it abundant in the Andes above Mendoza and it has also been reported from the Chilean side of the Andes. Colonies differ in armament. In cultivation some of the joints are elongated and club-shaped.

Illustration: Schumann Gesamtb. Kakteen f. 105, as *Opuntia grata.*

Figure 112 shows joints of the plant collected by Dr. Rose in 1915 at Potrerillos, Argentina.

70. **Opuntia sphaerica** Förster, Hamb. Gartenz. 17: 167. 1861.

Opuntia dimorpha Förster, Hamb. Gartenz. 17: 167. 1861.
Opuntia leonina Haage and Schmidt in Regel and Schmidt, Gartenflora 30: 413. 1881.
Opuntia leucophaea Philippi, Anal. Mus. Nac. Chile 1891[2]: 27. 1891.
Opuntia corotilla Schumann in Vaupel, Bot. Jahrb. Engler Beibl. 111: 28. 1913.

Plants often erect, always low, usually few-branched, often forming large patches; joints usually globular, 12 to 40 cm. in diameter; areoles large, numerous, sometimes nearly hiding the surfaces of the joints with their short brown wool; spines variable as to number, sometimes few, sometimes numerous, brown at first, in age sometimes gray, 1 to 4 cm. long, usually stiff; flowers 4 cm. long, deep orange; petals obtuse; fruit globular, often very spiny; seed globular, white, 4 mm. in diameter, surrounded by a thin, broad band.

Type locality: Near Arequipa, Peru.

Distribution: Central Peru to central Chile.

The three illustrations cited below were made from the same cultivated plant. They look very much like a poor specimen of *Opuntia glomerata*, and, if such it should prove, the name *O. leonina* should be referred to the synonymy of that species.

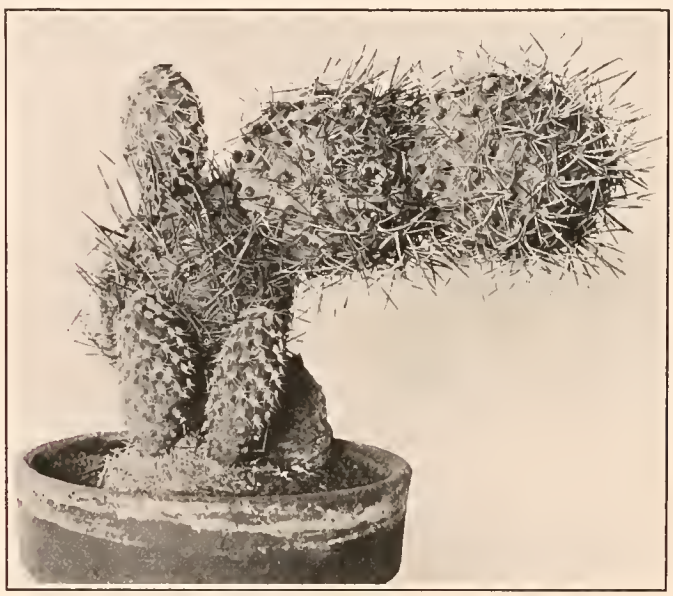


Fig. 113.—Opuntia sphaerica.

We have referred *Opuntia dimorpha* here with some hesitancy.

This plant often passes for *Opuntia ovata* and, from herbarium specimens we have seen, it has been so identified by Rudolph Philippi.

This species is very common in sandy places on hills, dry flats, and in mountain valleys, often covering the ground to the exclusion of all other plants. The joints readily break loose and, falling to the ground, start new colonies. We found the species very common both above and below Arequipa, Peru, where it is called corotilla; in central Chile it grows at lower altitudes but in similar situations. In Chile it is called leon or leoncito, which is probably the origin of the name *Opuntia leonina*.

Opuntia phyllacantha Haage and Schmidt (Regel and Schmidt, Gartenflora 30: 414. 1881), if it actually came from Chile, as stated, may belong here. The joints are more elongated, although the habit is somewhat similar. The illustration is poor and has doubtless been made from a greenhouse specimen. This name was given, with Salm-Dyck as authority, by Förster (Handb. Cact. 508. 1846), but without any description.

Illustrations: Cact. Journ. 1: 100; Förster, Handb. Cact. ed. 2. f. 133; Gartenflora 30: 413, all as *Opuntia leonina*.

Figure 113 is from a photograph of joints of the plant collected by Dr. Rose above Arequipa, Peru, in 1914.

71. **Opuntia skottsbergii** sp. nov.

Roots thick and fleshy, sometimes 10 cm. long, the plant doubtless more or less cespitose; joints, at least some of them, globular, 3 cm. in diameter, almost hidden by the numerous closely set spines; areoles close together, small, at times producing long tufts of white wool; spines about 10, black except the yellowish tips, 1 to 2 cm. long; glochids numerous, elongated; flowers, including the very

spiny ovary, about 6 cm. long; petals about 3 cm. long, drying reddish or reddish green; areoles of the ovary bearing 5 to 7 spines, which are brown or blackish below and with more or less yellowish tips; fruit not known.

Collected near Lake Buenos Aires, Territory of Santa Cruz, Argentina, December 12, 1908, by Carl Skottsberg (No. 675); and again on the Rio Fenix, north of the locality above given, December 10, 1908 (No. 625, type).

This species belongs to the subgenus *Tephrocactus*, but is not closely related to any of the described species. The flower resembles very much the one figured by Henslow as *O. darwinii*, and it is possible that he may have had some of this species in his *O. darwinii;* the plant bodies, however, are so different that one could hardly confuse the two.

Figure 114 is copied from a photograph of the type specimen above cited.

72. **Opuntia nigrispina** Schumann, Gesamtb. Kakteen 695. 1898.

Opuntia purpurea R. E. Fries, Nov. Act. Soc. Sci. Upsal. IV. 1[1]: 123. 1905.

Described as a shrub, 1 to 2 dm. high and much branched, the branches upright; joints dull green or reddish violet, 2 to 4 cm. long, 1 to 2 cm. in diameter, oblong-ellipsoid, terete, when young bearing decurrent, spirally arranged tubercles; areoles 2 to 3 mm. in diameter, bearing abundant

FIG. 114.—Opuntia skottsbergii.

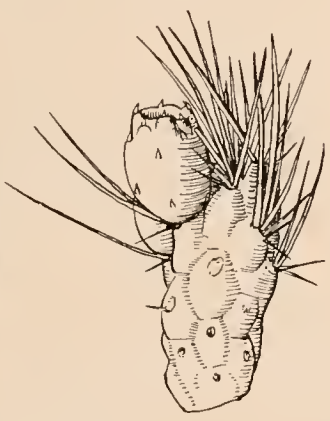


FIG. 115.—Opuntia nigrispina. ×0.8.

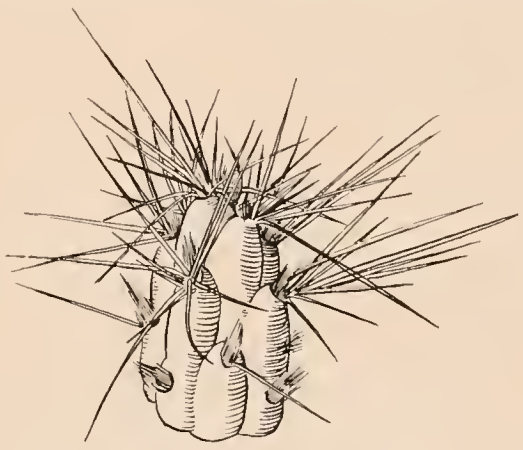


FIG. 116.—Opuntia pentlandii. ×0.4.

wool and glochids; spines 3 to 5 from upper areoles, 2.5 to 3 cm. long, straight, spreading, subterete, weak, purplish black; flowers small, purple, 2.2 to 2.5 cm. long; petals spatulate, 1.5 cm. long, 6 mm. broad; stigma-lobes 5; ovary 1 cm. long, obovoid, nearly smooth.

Type locality: On the puna of Humahuaca, Bolivia.

Distribution: Rare in stony mountains, altitude 3,500 meters, Jujuy, Argentina, and southern Bolivia.

Figure 115 represents a fruiting joint collected by J. A. Shafer at La Quiaca, Argentina, February 2, 1917 (No. 79).

73. **Opuntia pentlandii** Salm-Dyck, Allg. Gartenz. 13: 387. 1845.

Opuntia boliviana Salm-Dyck, Allg. Gartenz. 13: 388. 1845.
Opuntia pyrrhacantha Schumann, Gesamtb. Kakteen 694. 1898.
Opuntia dactylifera Vaupel, Bot. Jahrb. Engler Beibl. 111: 29. 1913.
Opuntia cucumiformis Griffiths, Bull. Torr. Club 43: 524. 1916. (From the description.)

Plant much branched, forming low, rounded, compact mounds sometimes a meter broad with hundreds of short stubby branches; joints obovoid to oblong-cylindric, plump, 2 to 10 cm. long, sometimes 4 dm. in diameter, more or less pointed, pale green or sometimes purplish, tuberculate; areoles small, circular, filled with short wool and yellow glochids, the upper ones sometimes also having spines; spines sometimes wanting, when present mostly from the upper areoles, erect, 2 to 10, usually bright yellow, sometimes brownish becoming dull brown, the longest one 7 cm. long; flowers

very variable in color and size, lemon-yellow to deep red, 2 to 3 cm. long, sometimes 5 cm. broad when fully expanded; petals obtuse; filaments short; style thick; stigma-lobes very short; ovary short with few areoles; areoles on ovary subtended by minute leaves, filled with short wool, the upper ones with bristle-like spines; fruit globular to short-oblong, 2 to 3 cm. long, dry; seeds numerous, 4 to 5 mm. long.

Type locality: In Bolivia.

Distribution: Very common on the high pampas of southeastern Peru and Bolivia, and adjacent Argentina.

Cactus pentlandii Lemaire (Cact. 88. 1868), name only, is supposed to apply to this species.

This is one of the most characteristic plants of the high pampas of the Andean region, mostly growing at elevations of 12,000 feet or higher, forming low, broad, compact clumps, sometimes made up of a hundred plants or more.

Illustrations: ?Dict. Gard. Nicholson 2: f. 751; ?Förster, Handb. Cact. ed. 2. f. 124; ?W. Watson, Cact. Cult. f. 77, all as *Opuntia boliviana*; Monatsschr. Kakteenk. 24: 175, as *Opuntia dactylifera*.

Figure 116 represents a joint of the plant collected in 1914 by Dr. Rose at Comanche, Bolivia; figure 117 shows a flowering joint collected by Dr. Rose in 1914, at Juliaca, Peru.

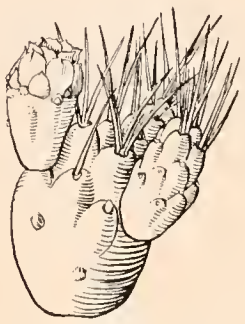


Fig. 117.—Opuntia pentlandii. ×0.4.

74. **Opuntia ignescens** Vaupel, Bot. Jahrb. Engler Beibl. 111: 30. 1913.

Plants forming clumps 2 dm. high or less, with hundreds of erect or spreading joints; joints bluish green, 8 to 10 cm. long, very fleshy, naked below; upper areoles very spiny; spines 6 to 15 from each areole, nearly equal, 4 to 5 cm. long, erect, acicular, yellow; flowers very showy, deep red; ovary oblong, 3 to 4 cm. long, naked below, but the upper areoles producing numerous spines 4 to 7 cm. long; fruit red, 7 cm. long, spiny and tuberculate above, terete below, with a deep umbilicus; seeds nearly globular, about 5 mm. in diameter.

Type locality: Near Sumbay, southern Peru.

Distribution: On the pampas of southern Peru and northern Chile, at altitude of 3,000 to 3,600 meters.

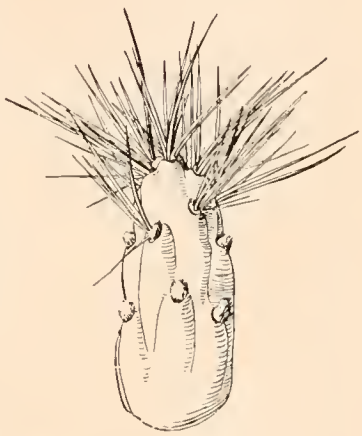


Fig. 118.—Opuntia ignescens. ×0.5.

Fig. 119.—Opuntia igneseens forming large mounds.

M. E. Eaton del.

1. Top of *Opuntia miquelii*. 2. Old and young joints of *Opuntia invicta*.
3. Upper part of joint of *Opuntia ignescens*. (All natural size.)

Plate XVI, figure 3, represents old and young joints of the plant collected above Ayrampl, Peru, by Dr. Rose in 1914. Figure 118 shows a fruit from the same plant; figure 119 is from a photograph taken by H. L. Tucker at Coropuna, Peru, in 1911.

75. Opuntia campestris sp. nov.

Much branched, often forming low, dense masses, 3 to 6 dm. in diameter; terminal joints readily breaking off; joints globular or a little longer than thick, 3 to 5 cm. long, with numerous prominent areoles, the tubercles conspicuous when young; leaves minute, 1 to 1.5 mm. long, caducous; glochids conspicuous, numerous, yellow; spines usually wanting at the lower areoles, present above, very unequal, 5 to 10, acicular, the longest ones 3.5 cm. long; flowers rosy white to light yellow, 2 to 3 cm. long; ovary naked or spiny; fruit thicker than long, 2.5 cm. long, with deep umbilicus, often very spiny.

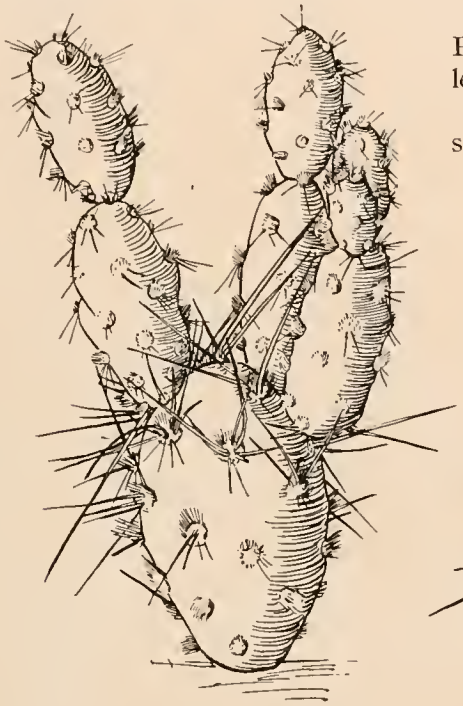


FIG. 120.—Opuntia campestris. ×0.8.

Common just below railroad station at Pampa de Arrieros, Peru, where it was collected by Dr. Rose, August 23, 1914 (No. 18957).

Figure 120 represents joints of the type specimen above cited.

FIG. 121.—Opuntia ignota. ×0.8.

76. Opuntia ignota sp. nov.

Low, much branched, spreading; joints small, narrow, 2 to 3 cm. long, more or less purplish; leaves minute, often purplish; spines 2 to 7 from an areole, brownish, acicular, the longest ones 4 to 5 cm. long; glochids, when present, yellow; areoles large, full of grayish wool; flowers and fruit not seen.

Collected by Dr. Rose on the hills below the railroad station at Pampa de Arrieros, Peru, August 23, 1914 (No. 18974).

Plants grown in greenhouses are dark green and develop few spines or none.

This plant grows in the same region as *O. campestris*, but is quite different from it.

Figure 121 shows joints of the type specimen above cited.

Subgenus 3. PLATYOPUNTIA.

Includes all the species with flattened joints; a few species have nearly terete joints; others have some of the joints terete. Twenty-eight series are recognized. The species are most abundant in North America, but several series are found only in South America, while others have representatives in both Americas. (See Key to the Series, p. 45.)

Series 1. PUMILAE.

Low, spiny species, with slightly flattened, narrowly cylindric or linear-oblong, readily detached ultimate joints, the main stem terete. We know three species, the typical one in Mexico and Guatemala, one from Oaxaca, Mexico, and one Peruvian. In the structure of their joints they form a transitional series between *Cylindropuntia* and *Platyopuntia*, and might be included in either of these subgenera with about equal reason.

Key to Species.

Young areoles with only 1 to 3 spines; joints 2 to 3 cm. thick.
- Plant 1 to 5 meters high; joints tubercled; spines yellowish . . . . . 77. *O. pumila*
- Plants about 2 dm. high; joints not tubercled; spines reddish to brown . . 77*a*. *O. depauperata*

Areoles with 3 to 7 spines; plants 1 to 4 dm. high.
- Joints 1 to 1.5 cm. thick; areoles not blotched; spines brownish . . . . 78. *O. pubescens*
- Joints 2 to 3 cm. thick; young areoles dark-blotched; spines yellowish . . . . . 79. *O. pascoensis*

Fig. 122.—Opuntia pumila forming low thickets.

77. **Opuntia pumila** Rose, Smiths. Misc. Coll. 50: 521. 1908.

Stems low, very much branched, the joints readily falling off when touched, 6 to 20 cm. long, velvety-pubescent, terete or sometimes slightly flattened, turgid, bearing more or less prominent tubercles; areoles small, those of old stems bearing several slender spines, the longer ones 3 cm. long; areoles of young joints usually bearing 2 yellowish spines; ovary pubescent, with few spines or none; petals yellow, tinged with red, 15 mm. long; fruit globular, red, 15 mm. long.

Type locality: Near Oaxaca City, Mexico, on the road to Mitla.

Distribution: Central and southern Mexico.

When this species was described, attention was called to various forms which belonged here or to one or more related species. These we now refer to *O. pubescens*.

Figure 122 is from a photograph of the type; figure 123 represents joints of the same.

77*a*. **Opuntia depauperata** sp. nov. (See Appendix, p. 216.)

78. **Opuntia pubescens** Wendland* in Pfeiffer, Enum. Cact. 149. 1837.

Opuntia leptarthra Weber in Gosselin, Bull. Mus. Hist. Nat. Paris 10: 393. 1904.

Plants small, usually low, sometimes 4 dm. high, much branched; joints easily becoming detached, nearly terete, glabrous or pubescent, 3 to 7 cm. long; spines numerous, short, brownish; flowers lemon-yellow but drying red; filaments greenish; style white; stigma-lobes cream-colored; fruit small, 2 to 2.5 cm. long, red, a little spiny, with a depressed umbilicus; seeds small, 3 mm. in diameter.

Type locality: In Mexico.

Distribution: Northern Mexico to Guatemala.

This species was sent to the Exposition Universelle at Paris by the Mexican Government in 1889, and was there seen and described by Dr. Weber as *O. leptarthra*. A part of this material finally went to the Hanbury Garden at La Mortola, Italy, whence we obtained specimens in 1913 which prove to be identical with specimens obtained by Dr. Rose and others in Mexico and Guatemala in 1905 to 1909.

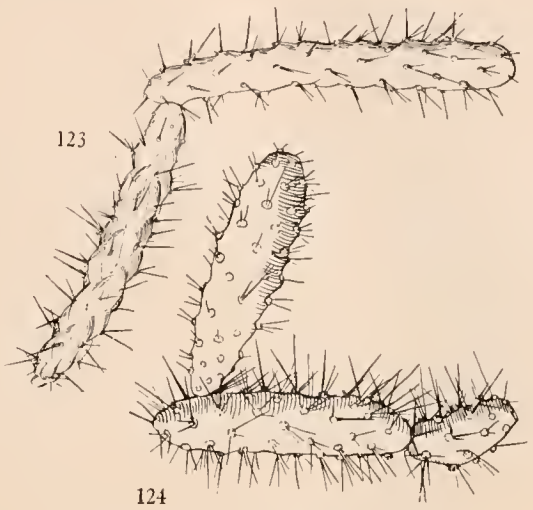


Fig. 123.—Opuntia pumila. ×0.4.
Fig. 124.—Opuntia pubescens. ×0.75.

This is an insignificant species and hence has generally been overlooked in the region where so many more striking species are found. It is widely distributed, extending from the State of Tamaulipas, in Mexico, to Guatemala, a much greater range than that of most species. Its wide distribution is doubtless due to the fact that the joints, which are covered with barbed spines and are easily detached, fasten themselves to various animals and are scattered like burs over the country; each little joint thus set free starts a new center of distribution.

This is a difficult plant to grow in greenhouses, for the spreading or hanging branches soon become entangled with other plants and break off in attempts to free or move them; partly for this reason, doubtless, it rarely flowers in cultivation.

Opuntia angusta Meinshausen (Wochenschr. Gärtn. Pflanz. 1: 30. 1858) was unknown to Schumann. It was originally described as similar to the South American species, *O. aurantiaca*, and, if so, it must be near *O. pubescens*, if not identical with it, being a native of Mexico, where it was first collected by Karwinsky.

Figure 124 represents joints of the Guatemalan plant, cultivated in the greenhouses of the United States Department of Agriculture, Washington, obtained in 1907.

79. **Opuntia pascoensis** sp. nov.

Stems erect and rigid, up to 3 dm. high; joints easily breaking apart, erect or ascending, terete or slightly flattened, 3 to 12 cm. long, 1.5 to 4 cm. broad, puberulent, hardly tuberculate but with faint upturned lunate depressions between the dark-blotched areoles; leaves minute; areoles somewhat elevated, filled with brown wool intermixed with longer white cobwebby hairs; spines 4 to 8 on young joints, more on older joints, acicular, yellow, 2 cm. long or less; glochids numerous, short, yellow, tardily developing; fruit globular, 1.5 cm. in diameter, naked below, spiny above. Doubtless of wide distribution, for the joints are easily detached and are distributed like burs, but so far only two collections have been reported.

*Pfeiffer (Enum. Cact. 1837) frequently refers several of Wendland's species to Catal. h. Herrnh. 1835, but we can find no references to Wendland having published a catalogue of the Herrenhausen Garden either in 1835 or about that time. We have therefore cited all of Wendland's species so referred by Pfeiffer to the pages given in his Enumatio.

Collected by Dr. and Mrs. J. N. Rose in central and southern Peru, in 1914, first from just below Matucana (No. 18653), and later at Pasco (No. 18812, type).

Plate XVII, figure 1, represents a joint of the type specimen above cited.

Series 2. CURASSAVICAE.

This series is composed of 10, or perhaps 11, species of low plants, characterized by their fragile branches, the small joints separating and becoming detached very readily, more or less flattened or subterete. They mostly inhabit the southern United States and the West Indies; one is known from Ecuador; the original home of one of the species recognized is unknown.

KEY TO SPECIES.

Spines acicular.
- Joints oval, mostly not more than twice as long as wide; plants prostrate, little branched.....80. *O. curassavica*
- Joints oblong to linear, 2 to 8 times as long as wide; plants ascending or erect, much branched.
  - Joints narrowly linear, 1 to 2 cm. wide.....81. *O. taylori*
  - Joints oblong to linear-oblong or obovate-oblong, 2 to 4 cm. wide.
    - Joints oblong to linear, 4 to 8 times as long as wide; spines 1 to 3 cm. long.
      - Joints not tubercled.....82. *O. repens*
      - Joints tubercled, at least when young.....82a. *O. pestifer*
    - Joints oblong to obovate-oblong, 2 to 3 times as long as wide; spines 3 to 5 cm. long.....83. *O. borinquensis*

Spines subulate.
- Spines white.
  - Roots fibrous; spines at most of the areoles.....84. *O. militaris*
  - Roots tuberous; spines only at the upper areoles.....85. *O. nemoralis*
- Spines brown.
  - Joints oval to oblong.
    - Joints scarcely repand; plant up to 2 dm.....86. *O. drummondii*
    - Joints strongly repand; plant 1 dm.....87. *O. tracyi*
  - Joints linear-lanceolate.....88. *O. pusilla*

Affinity uncertain.....89. *O. darrahiana*

80. Opuntia curassavica (Linnaeus) Miller, Gard. Dict. ed. 8. No. 7. 1768.

Cactus curassavicus Linnaeus, Sp. Pl. 469. 1753.

Stems low, 5-jointed, light green, prostrate and creeping or hanging over rocks; joints oval to oblong, decidedly flattened but thick, 2 to 5 cm. long, glabrous; leaves minute, soon withering; areoles small, bearing short wool and longer, white cobwebby hairs; spines 4 to many, acicular, 2.5 cm. long or less, yellowish, becoming white in age; glochids tardily developing.

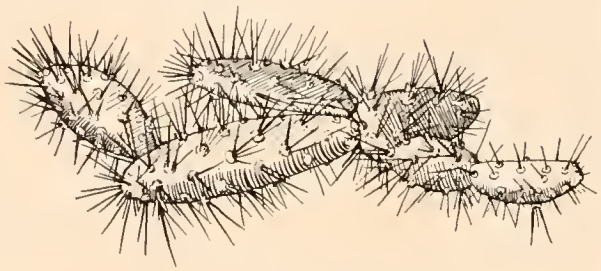


FIG. 125.—Opuntia curassavica. ×0.75.

Type locality: Curaçao Island.

Distribution: Curaçao, Bonaire, and Aruba.

Haworth (Syn. Pl. Succ. 196. 1812) describes three varieties, *major*, *media*, and *minor*, and later (Rev. Pl. Succ. 71. 1821) also describes the variety *longa*. *O. curassavica elongata* Haworth (Salm-Dyck, Hort. Dyck. 184. 1834), a name only, is supposed to be the same as var. *longa*.

This is one of the oldest species of *Opuntia*, having been described and figured as early as 1696. For a long time it has been unknown, the name having been transferred to a similar species, *O. repens*. In 1913 Dr. Britton visited Curaçao, its native home, and re-collected it. Its flowers have not been described, and several residents informed him that they had never seen it in flower; Dr. Britton did not find it in flower on Curaçao, nor has it flowered with us in cultivation; Haworth, who wrote about it in 1812, speaks of its being a shy bloomer, saying he had seen it in flower but once. In early English books it is called pin pillow, because its turgid joints suggest pincushions filled with pins.

Illustrations: Bradley, Hist. Succ. Pl. ed. 2. pl. 4, as *Opuntia minima americana*, etc.; Commerson Hort. pl. 56, as *Opuntia curassavica minima;* Plukenet, Opera Bot. 3: pl. 281, f. 3, as *Opuntia minor caulescens*.

Figure 125 represents the plant collected on Curaçao by Dr. N. L. Britton and Dr. J. A. Shafer in 1913.

M. E. Eaton del.

1. Joint of *Opuntia pascoensis*.
2. Joints of *Opuntia taylori*.
3, 4. Forms of *Opuntia repens*.
5. Flower of same.
6. Flowering joint of *Opuntia drummondii*.

(All natural size.)

81. Opuntia taylori Britton and Rose, Smiths. Misc. Coll. 50: 520. 1908.

Opuntia hattoniana Britton and Rose in Johnston and Tryon, Rep. Prickly-Pear Comm. 97. 1914.

Prostrate, widely branched; joints linear to linear-oblong, 12 cm. long or less, bright green, 1 to 2 cm. wide, turgid, glabrous or pubescent; areoles 1 to 1.5 cm. apart, not elevated; spines acicular, 3 to 6 at each areole, yellowish brown, becoming white, 4 cm. long or less; glochids yellowish brown, 3 mm. long; flowers yellow, small, the petals about 1 cm. long; ovary pyriform, 1 to 1.5 cm. long, its areoles with few bristles and spineless.

Type locality: Between Gonaives and La Hotte Rochée, on road to Terre Neuve, Haiti.

Distribution: Deserts of Haiti and of Azua, Santo Domingo.

This species, while similar to *O. repens*, has more terete joints.

It was first collected in 1905 in Haiti by Nash and Taylor, and upon this collection the species was based. In 1913 Rose, Fitch, and Russell collected it in the Azua desert of Santo Domingo. In this last collection the joints are pubescent, but otherwise the plants seem to be the same, although we at one time thought they might be distinct; in fact, in their report on the opuntias, Johnston and Tryon published the Santo Domingo plant as new, from notes given to them.

Plate XVII, figure 2, represents joints of the plant collected by Rose, Fitch, and Russell at Azua, Santo Domingo, in 1913.

82. Opuntia repens Bello, Anal. Soc. Esp. Hist. Nat. 10: 277. 1881.

Stems erect or ascending, 5 dm. high or less, commonly much branched, often forming dense, flat masses 4 meters in diameter, glabrous or pubescent, green or olive-green; joints oblong to linear 5 to 16 cm. long, 3.5 cm. broad or less, usually strongly flattened; areoles small, bearing brown wool and a few cobwebby white hairs; spines when very young pinkish, becoming brown, afterwards fading out, acicular, numerous, 3.5 cm. long, or less; glochids numerous, yellow, tardily developing; flowers 4 cm. broad, bright yellow, fading to salmon-colored; ovary and fruit with or without spines; fruit red, 2 to 3 cm. long, 1 to few-seeded.

Type locality: Near Guanica, Porto Rico.

Distribution: Porto Rico and its islands, Mona, Muertos, Vieques, and Culebra, to Virgin Gorda and St. Croix.

Opuntia repens has long been confused with *O. curassavica*. It was first collected on St. Thomas, where it is abundant and a troublesome weed, and was illustrated by Pfeiffer and Otto in the year 1843. It was described by Bello in 1881, who thought it might be a variety of *O. spinosissima*. According to Bello, it is called olaga in Porto Rico, which is a corruption of ohulaga; the name suckers is used for it in the Virgin Islands. The plant is freely distributed by its fragile, clinging joints. Unlike its relative, *O. curassavica*, this plant flowers freely, blooming in late spring and summer.

Opuntia repens Karwinsky in Salm-Dyck (Hort. Dyck. 361. 1834) has been published only as a synonym, and therefore does not invalidate the use of Bello's name.

The plant is recorded by Johnston and Tryon (Rep. Prickly-Pear Comm. 95. 1914) as *O. curassavica taylori*.

Illustration: Pfeiffer and Otto, Abbild. Beschr. Cact. 1: pl. 6, f. 2, as *Opuntia curassavica*.

Plate XVII, figure 3, represents joints of the plant collected near Guanica, Porto Rico, by Dr. Britton in 1913; figure 4 is from a plant obtained by the same collector the same year on Virgin Gorda; figure 5 is copied from the illustration above cited.

82*a*. Opuntia pestifer sp. nov. (See Appendix p. 217.)

83. Opuntia borinquensis sp. nov.

Plants few-branched, forming colonies often 2 meters across, 5 dm. high or less; joints readily detached, oblong to obovate-oblong, dull green, glabrous, compressed but turgid, 5 to 8 cm. long, 4 cm. wide or less, about 1.5 cm. thick; areoles small, 1 to 2 cm. apart, bearing 2 or 3 acicular spines,

the larger up to 6 cm. long, brown when young, fading white; leaves subulate, acuminate, 1 to 2 mm. long; fruit obovoid, subtruncate, 1.5 cm. long.

Limestone swale, Morillos de Cabo Rojo, Porto Rico (Britton, Cowell, and Brown, No. 4741), growing with *O. repens* Bello, from which it differs by its larger, broader, and flatter joints and much longer spines.

The only locality known for this plant is at the extreme southwestern corner of Porto Rico, where numerous colonies of it were observed. The region is a very dry one, rain falling there only at long intervals; the associated vegetation is of a highly xerophytic character.

Figure 126 represents joints of the type specimen above cited.

84. **Opuntia militaris** sp. nov.

Stems 3 dm. tall, the branches weak and more or less spreading; joints thick, narrowly oblong to obovate, 5 to 8 cm. long, somewhat shiny when young, easily breaking apart; spines 1 or 2 from an areole, occasionally more, acicular, white, 1 to 2 cm. long; flower-buds pointed; flowers small, 3 cm. long; petals greenish to cream-colored, tinged with pink; ovary small, its small areoles without spines.

Collected by Dr. N. L. Britton, March 17 to 30, 1909, at the U. S. Naval Station, Guantánamo Bay, Oriente, Cuba (No. 1957).

Figure 127 represents joints of the type specimen above cited.

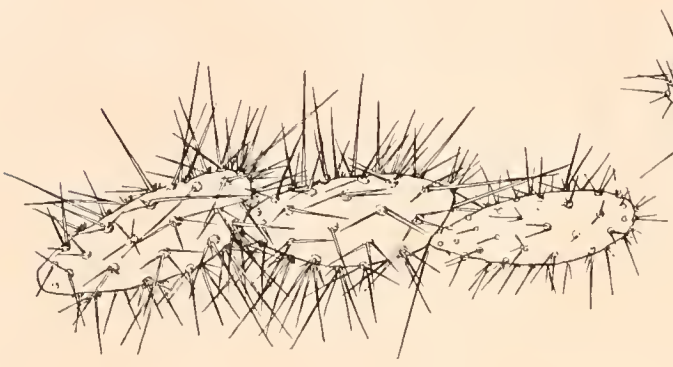


FIG. 126.—Opuntia borinquensis. ×0.5.

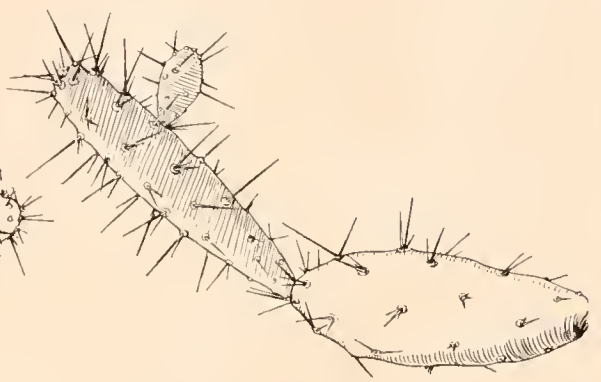


FIG. 127.—Opuntia militaris. ×0.5.

85. **Opuntia nemoralis** Griffiths, Monatsschr. Kakteenk. 23: 133. 1913.

Plants low, usually prostrate, forming clumps 1 meter in diameter, sometimes 3 dm. high; joints ovate to obovate, thick, 7 to 9 cm. long, green, but often with purple blotches about the areoles; spines 1 or 2, only from the upper areoles, 2 to 2.5 cm. long, mostly erect; glochids yellow; flowers yellow; fruit obovoid to pyriform, small, 3 cm. long, light red, truncate.

Type locality: Longview, Texas.

Distribution: Pine woods and fields about Longview, Texas.

This species in habit, joints, and spines suggests the *Tortispinae;* but on account of having easily detached joints we have referred it to the *Curassavicae*, as indicated in the original description, placing it between the Cuban species *O. militaris* and the United States species *O. drummondii*. It is known only from the type specimens.

86. **Opuntia drummondii** Graham in Maund, Botanist 5: pl. 246. 1846.

Opuntia pes-corvi LeConte in Engelmann, Proc. Amer. Acad. 3: 346. 1856.
Opuntia frustulenta Gibbes, Proc. Elliott Soc. Nat. Hist. 1: 273. 1859.

Plant prostrate or spreading, 2 dm. or less high, from thickened single or sometimes moniliform roots; joints rather variable, narrowly linear to broadly oblong, with entire margins, sometimes 12 cm. long and 5 to 6 cm. broad, usually light green, sometimes darker about the areoles; leaves 2 to

M. E. Eaton del. 1 to 3
H. A. Wood del. 4, 5

1. Two plants of *Opuntia drummondii*.
2. Joints of *Opuntia retrorsa* with flower.
3. Joints of *Opuntia triacantha*.
4, 5. Joint and section of fruit of *Opuntia jamaicensis*.

(All natural size.)

6 mm. long; spines (if present) solitary or 2 to 4, brownish red or gray, 2 to 4 cm. long; flowers yellow, 6 cm. broad; petals obovate; fruit red, juicy but insipid, obovoid to clavate, 22 to 35 mm. long, 15 mm. in diameter at thickest part, bearing few areoles and no spines; umbilicus slightly depressed in the center; seeds 1 to 8, about 4 mm. broad.

Type locality: Apalachicola, Florida.

Distribution: Sandy soil from northern Florida to Pamlico Sound, North Carolina.

In February 1916, Dr. J. K. Small visited the coastal islands near Charleston, South Carolina, for the purpose of collecting Gibbes's *Opuntia frustulenta*. He found this species very common on Folly Island and on the Isle of Palms, where it grows abundantly in the sand, and also very variable as to shape and size of joints. He says the joints break off easily and attach themselves to one's clothing like the sand spur, making progress over these islands difficult and painful. It is the common belief that this species rarely flowers. It usually flowers when first brought into cultivation, but rarely afterward, this doubtless being due to unsuitable greenhouse conditions.

The fruit described was collected by Dr. J. K. Small, December 10, 1917, at Apalachicola, Florida, the type locality.

According to Professor L. R. Gibbes, it is known as dildoes about Charleston.

Illustration: Maund, Botanist 5: pl. 246.

Plate XVII, figure 6, represents flowering joints of a plant sent from La Mortola, Italy, to the New York Botanical Garden in 1912; plate XVIII, figure 1, shows the plant collected by Dr. Small on the Isle of Palms, South Carolina, in 1916.

Herbarium specimens apparently representing a related species, were collected by W. L. McAtee at Cameron, Louisiana, in 1910 (No. 1955).

FIG. 128.—Opuntia tracyi.

87. Opuntia tracyi Britton, Torreya 11: 152. 1911.

Low, diffusely much branched, pale green, about 2 dm. high or less; older joints oblong to linear-oblong, flat, 6 to 8 cm. long, 1.5 to 2.5 cm. wide, about 1 cm. thick; young joints scarcely flattened or terete, 1 cm. thick; areoles elevated, 5 to 10 mm. apart; spines 1 to 4, acicular, light gray with darker tips, 3.5 cm. long or less; glochids numerous, brownish; corolla pure yellow, 4 cm. broad; ovary 1.5 cm. long, bearing a few triangular acute scales similar to the outermost sepals, which are 2 mm. long; sepals triangular-ovate, 5 to 15 mm. long, the outer green, the inner yellowish with a green blotch; petals obovate, apiculate, 2 to 2.5 cm. long; filaments yellow, 1 cm. long; anthers white.

In sandy soil near the coast, Biloxi, Mississippi.

Figure 128 is from a photograph of the plant collected by S. M. Tracy at Biloxi, Mississippi, in 1911.

88. Opuntia pusilla Haworth, Syn. Pl. Succ. 195. 1812.

Cactus pusillus Haworth, Misc. Nat. 188. 1803.
Cactus foliosus Willdenow, Enum. Pl. Suppl. 35. 1813.
Opuntia foliosa Salm-Dyck in De Candolle, Prodr. 3: 471. 1828.

Low, usually prostrate; joints narrow, more or less flattened, sometimes nearly terete, hardly tuberculate, light green in color; leaves 6 mm. long, linear, early deciduous; areoles remote; spines

1 or 2, subulate, usually brownish when young, in age straw-colored; flowers pale yellow, rather large for the plant; petals few, about 8, spreading, acute.

Type locality: Not cited.

Distribution: Usually assigned to South America, but not known from any definite locality; Schumann, in his Keys, however, says West Indies.

This species has usually passed under the name of *O. foliosa*, although all writers seem to agree that the older name, *O. pusilla*, was given to the same species. It may belong in the series *Aurantiacae* rather than in the *Curassavicae*.

Specimens distributed from European gardens as *O. foliosa* in recent years are not typical, and are probably referable to *O. drummondii*.

Tephrocactus pusillus Lemaire (Cact. 88. 1868), an unpublished name, referred by Lemaire to his third section of *Tephrocactus*, may belong here. The Index Kewensis refers it to *Opuntia pusilla*.

Illustration: Pfeiffer and Otto, Abbild. Beschr. Cact. 1: pl. 18, as *Opuntia foliosa*.

Figure 129 is copied from the illustration above cited.

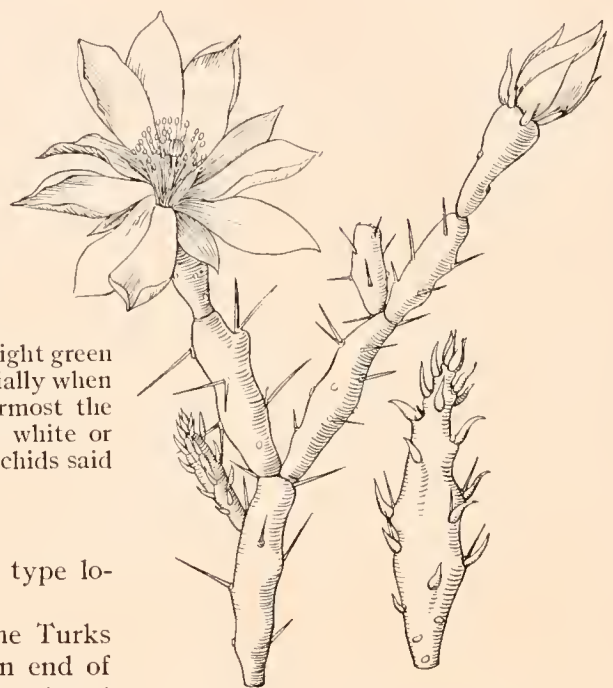


FIG. 129.—Opuntia pusilla.

89. Opuntia darrahiana Weber in Gosselin, Bull. Mus. Hist. Nat. Paris 10: 388. 1904.

Growing in masses, 2 to 2.5 dm. high 3.5 to 4 dm. broad, very much branched, joints 7 to 8 cm. long by 4 to 5 cm. broad, bright green to sea-green; areoles somewhat elevated, especially when young, 1 cm. apart; spines 6, the two uppermost the longest, these 4 to 4.5 cm. long, all suberect, white or grayish white, more or less brownish at tip; glochids said to be wanting; flowers and fruit not known.

Type locality: Turks Islands.

Distribution: Known only from the type locality.

This species is known only from the Turks Islands, a small group at the southeastern end of the Bahaman Archipelago. It was introduced into Europe by the late Charles Darrah.

We know the plant only from the above-cited description, and, so far as we have been able to learn, it is not now in cultivation, nor have we been able to find any herbarium specimens preserved. The opuntias known to us to inhabit Turks Islands are *O. dillenii*, *O. nashii*, and *O. lucayana*. The description of *O. darrahiana* does not agree with any of these. The species is referred to the series *Curassavicae* with doubt, but as this series has representatives in Florida, Cuba, and Hispaniola, the existence of one in the Bahamas is not improbable.

Series 3. AURANTIACAE.

The species of this series are low plants, mostly with readily detached joints; the main stems are often terete or turgid, the ultimate joints narrow and flat. They inhabit southeastern South America. During the expedition to Brazil and Argentina conducted by Dr. Rose in the summer of 1915, only a few of the species here grouped were found; Dr. Shafer collected several of them in the winter of 1916–17. Dr. Spegazzini has given us photographs of several.

We recognize 8 species, and have appended another, which may belong here.

Key to Species.

Joints not conspicuously purple-blotched under the areoles.
- Joints linear, elongated.
  - Stem terete or subterete; branches mostly flat.
    - Joints dark green, not tubercled ..... 90. *O. aurantiaca*
    - Joints tubercled, bluish green when young ..... 91. *O. schickendantzii*
  - All the joints flat.
    - Joints elongated, linear ..... 92. *O. kiska-loro*
    - Joints linear-oblong ..... 93. *O. canina*
- Joints short, elliptic ..... 94. *O. montevidensis*

Joints with a long purplish blotch under each areole.
- Joints more or less spiny.
  - Joints flattened.
    - Joints 2 to 3.5 cm. wide ..... 95. *O. retrorsa*
    - Joints 3.5 to 6 cm. wide ..... 96. *O. utkilio*
  - Joints subterete, turgid ..... 96*a*. *O. discolor*
- Joints spineless ..... 97. *O. anacantha*

Perhaps of this series ..... 98. *O. grosseiana*

90. Opuntia aurantiaca Lindley, Edwards's Bot. Reg. 19: pl. 1606. 1833.

Opuntia aurantiaca extensa Salm-Dyck in Förster, Handb. Cact. 476. 1846.

Low, much branched, and spreading; stem terete or subterete, 1 to 2 cm. thick; joints very fragile, linear, 6 to 8 cm. long, 1.5 to 2.5 cm. broad, almost terete at base, dark green, shining; areoles somewhat elevated, filled with white wool; spines 2 or 3, brownish, 1 to 3 cm. long; flowers yellow, 2.5 cm. broad; fruit 2 to 2.5 cm. long.

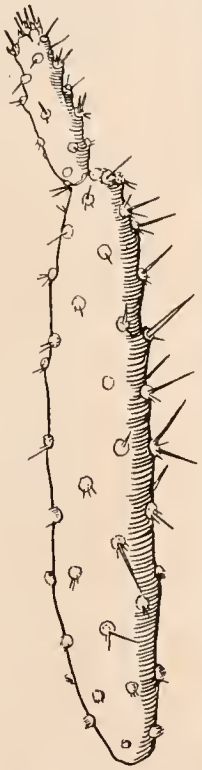


Fig. 130.—O. aurantiaca.

Fig. 131.—O. schickendantzii.

Type locality: Chile (in error).

Distribution: Argentina and Uruguay.

Cactus aurantiacus Lemaire (Cact. 87. 1868) is usually cited in synonymy, but Lemaire only mentions the name as a species of *Cactus*. It is in fact Gillies's manuscript name, first published in the Botanical Register in 1833 as a synonym of *O. aurantiaca*.

O. extensa Salm-Dyck (Pfeiffer, Enum. Cact. 147. 1837) is also given as a synonym.

Remy states (Gay, Fl. Chilena 3: 25. 1847) that it grows in the central provinces of Chile, but he probably had in mind some other plant, as *O. aurantiaca* is not known to be native of Chile by resident botanists.

Illustrations: Anal. Mus. Nac. Montevideo 5: pl. 34; Edwards's Bot. Reg. 19: pl. 1606.

Figure 130 represents a joint from a plant found by Dr. Rose, in Argentina, in 1915.

91. Opuntia schickendantzii Weber in Schumann, Gesamtb. Kakteen 688. 1898.

Shrub-like, 1 to 2 meters high, much branched, grayish green; branches cylindric or flattened, somewhat tuberculate; leaves minute, 2 mm. long, reddish; spines 1 or 2, subulate, 1 to 2 cm. long; flowers 4 cm. in diameter, yellow; fruit green, sterile.

Type locality: In Tucuman, Argentina.

Distribution: Northern Argentina.

Figure 131 is from a photograph of a plant in Argentina contributed by Dr. Spegazzini.

FIG. 132.—Opuntia kiska-loro.

92. **Opuntia kiska-loro** Spegazzini, Anal. Mus. Nac. Buenos Aires III. 4: 516. 1905.

Prostrate, rooting, forming spreading clumps 3 to 6 dm. high; joints flat, at first very narrow, becoming lanceolate, 20 cm. long, 4 cm. broad, shining green; spines 2 to 4, unequal, whitish, 4 to 6 cm. long; flowers orange, rather large, 3 to 6 cm. broad; filaments pale orange; stigma-lobes 6, flesh-colored; fruit 5 cm. long, deep violet-purple without, white within; seeds 5 mm. broad, pubescent.

Type locality: Deserts of La Rioja, Catamarca, Argentina.

Distribution: Northwest Argentina.

Figure 132 is from a photograph of the type plant sent by Dr. Spegazzini.

93. **Opuntia canina** Spegazzini, Anal. Mus. Nac. Buenos Aires III. 4: 518. 1905.

At first erect, then decumbent, 1 to 3 meters broad; joints flat, very narrow, attenuate at both ends, 2.5 to 3.5 dm. long, 4.5 cm. broad, shining green; areoles on young joints unarmed; spines of areoles of older joints 1 or 2, sometimes 3, 1.5 to 3.5 cm. long, reflexed, subterete, grayish white with yellowish tips; flowers numerous, medium sized; ovary obovoid; corolla rotate, yellowish orange, 4 to 5 cm. broad; petals obovate; filaments yellow; stigma-lobes 5; fruit obovoid, 2.6 to 2.8 cm. long, red without, white within; seeds 4 mm. broad, white, lanate.

FIG. 133.—Opuntia canina.

Type locality: Near Pampablanca, Jujuy, Argentina.

Distribution: Provinces of Jujuy and Tucuman, Argentina.

Figure 133 is from a photograph sent by Dr. Spegazzini.

94. Opuntia montevidensis Spegazzini, Anal. Mus. Nac. Buenos Aires III. 4: 515. 1905.

Cespitose, the branches 3 to 5 dm. high; joints 5 to 10 cm. long, obovate to elliptic; areoles not very prominent; spines usually 5, 3 longer and stouter, 2 very small, reflexed, and setiform, the 2 or 3 longer ones erect or spreading, 2 to 3 cm. long; flowers 4 to 5 cm. broad, orange-colored; fruit dark purple, clavate, 3.5 to 4 cm. long ; seeds lanate.

Type locality: Cerro de Montevideo, Uruguay.

Distribution: Cerro de Montevideo, and near La Colonia, Uruguay.

95. Opuntia retrorsa Spegazzini, Anal. Mus. Nac. Buenos Aires III. 4: 517. 1905.

(?) *Opuntia platynoda* Griffiths, Bull. Torr. Club 43: 526. 1916.

Stems prostrate, intricately branched, creeping, rooting at the nodes; joints linear-lanceolate, more or less attenuate at each end, flattened; areoles somewhat prominent, each subtended by a long, dull purplish blotch; spines 1 to 3, reflexed, white below, with pinkish tips; flowers yellowish, 4 to 5 cm. broad; fruit about 2 cm. long, violet-purple on the outside, light rose on the inside; seeds 2 to 2.5 mm. broad, somewhat villous.

FIG. 134.—Opuntia retrorsa.

Type locality: In the Territory of the Chaco, Argentina.

Distribution: Northern Argentina.

Plate XVIII, figure 2, represents a plant from Argentina which flowered at the New York Botanical Garden in 1911. Figure 134 is from a photograph sent by Dr. Spegazzini.

96. Opuntia utkilio Spegazzani, Anal. Mus. Nac. Buenos Aires III. 4: 516. 1905.

Low, creeping plant, rooting at the joints, with elongated branches 5 to 15 dm. long; joints flat, elliptic-linear, 15 to 30 cm. long, 5 to 6 cm. broad; spines at first 2 or 3, the upper one longer, later more numerous, reflexed; flowers small, 3.5 to 4 cm. broad, yellowish; ovary obovoid, somewhat spiny; fruit small, 3 cm. long, fleshy, insipid, reddish violet both within and without; seeds suborbicular, 4 mm. broad, lanate.

Type locality: Province of Tucuman, Argentina.

Distribution: Northern Argentina.

Figure 135 is from a photograph sent by Dr. Spegazzini.

96*a*. Opuntia discolor sp. nov. (See Appendix, p. 218.)

97. Opuntia anacantha Spegazzini in Gosselin, Bull. Mus. Hist. Nat. Paris 10: 391. 1904.

Usually decumbent and rooting along the under surface, sometimes ascending and clambering, 1 to 2.5 meters long; joints unarmed, dark green except for purple spots under the areoles, elliptic to lanceolate, narrowed toward each end, 1.5 to 4 dm. long, 3.5 to 7 cm. broad; areoles small; flowers large, numerous, yellowish orange, 4 cm. long, 5 to 6 cm. in diameter; sepals large, reddish, obtuse, emarginate or even 2-lobed; petals 12; style white; stigma-lobes white or rose-colored; fruit 3 cm. long, red, the pulp yellowish or white.

Type locality: In the southern Chaco, Argentina.

Distribution: Northeastern Argentina.

Figure 136 is from a photograph of a part of the type plant, received from Dr. Spegazzini.

98. Opuntia grosseiana Weber in Gosselin, Bull. Mus. Hist. Nat. Paris **10**: 391. 1904.

Described as having joints intermediate between those of *Opuntia elata* and *O. anacantha*, and resembling these species.

Type locality: In Paraguay.
Distribution: Paraguay.
Introduced from Paraguay by Hermann Grosse; known to us only from the description.

Series 4. TUNAE.

Bushy, ascending, depressed, or erect plants, with rather large and more or less readily detached joints, bearing acicular or subulate, often numerous, yellow or white spines. The species inhabit the West Indies, Mexico, Guatemala, and northern South America.

FIG. 135.—Opuntia utkilio.

FIG. 136.—Opuntia anacantha.

KEY TO SPECIES.

Joints glabrous.
- Spines slender, acicular.
  - Spines white.
    - Joints dull.
      - Joints dark green, repand; areoles somewhat elevated. . . . . 99. *O. bella*
      - Joints light green, not repand; areoles not elevated.
        - Spines several at the areoles; plant ascending. . . . . 100. *O. triacantha*
        - Spines 1 to few at the areoles or often wanting; plant erect . . . . . 101. *O. jamaicensis*
    - Joints shining . . . . . 101*a*. *O. guatemalensis*
  - Spines yellow, at least when young; plant bushy branched. . . . . 102. *O. tuna*
- Spines stout, subulate.
  - Spines white; joints relatively thick, turgid. . . . . 102*a*. *O. pennellii*
  - Spines yellow, at least when young; joints relatively thin.
    - Plants low, spreading, 2 dm. high or less.
      - Joints repand; spines bright yellow. . . . . 103. *O. antillana*
      - Joints not repand; spines pale yellow. . . . . 103*a*. *O. caracasana*
    - Plants tall, 1 to 2 meters high.
      - Joints obovate or broadly elliptic. . . . . 104. *O. wentiana*
      - Joints narrowly oblong or oblong-obovate. . . . . 104*a*. *O. aequatorialis*

Joints pubescent.
Areoles surrounded by purplish spots..... 105. *O. decumbens*
Areoles not surrounded by purplish spots..... 106. *O. depressa*

99. Opuntia bella sp. nov.

Stems low, 10 to 12 dm. high, forming thickets; joints oblong, repand, 10 to 16 cm. long, dull dark green; areoles 1 to 2 cm. apart, somewhat elevated, small, filled with short brown wool and glochids; leaves minute, 1.5 to 2.5 mm. long; spines white, 2 to 6, unequal, acicular, the longer ones about 2 cm. long; flowers 5 cm. long, "sulphur-yellow turning to orange-red;" petals 20 to 22 mm. long; ovary deeply umbilicate; "fruit small, greenish yellow."

137.—Opuntia bella in the foreground.

Type locality: Venticas del Dagua, Dagua Valley, western cordillera of Colombia.
Distribution: Western Colombia.

The type is based upon plants collected by Mr. Henry Pittier in the State of Cauca, Colombia, in 1906, and grown ever since in Washington and New York. The species is very common in Cauca, forming with other cacti impenetrable thickets.

Figure 137 is from a photograph by Mr. Pittier of the type plant, taken near Cauca, Colombia, in 1906; figure 138 is from a photograph by the same collector, showing flowering and fruiting joints; figure 139 represents a single joint.

100. Opuntia triacantha (Willdenow) Sweet, Hort. Brit. 172. 1826.

Cactus triacanthos Willdenow, Enum. Pl. Suppl. 34. 1813.

Stems half procumbent or clambering over rocks, sometimes even erect but always low; joints turgid, oblong, 4 to 8 cm. long, the terminal and often the second and third ones breaking off easily; spines usually 3, white but often drying yellowish, 4 cm. long or less; flowers, including the ovaries, 5 cm. long, brownish yellow to cream-colored, tinged with pink; petals obtuse; filaments and style pale green; fruit 2.5 cm. long, red, spineless.

Type locality: Not cited; cultivated in the Berlin Garden.

Distribution: Desecheo Island, Porto Rico; Lesser Antilles, St. Thomas to Guadeloupe.

FIG. 138.—Opuntia bella. ×0.75.

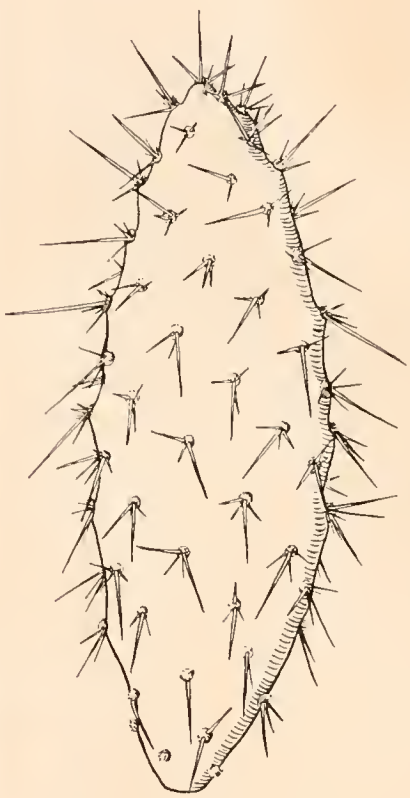


FIG. 139.—Opuntia bella. ×0.66.

When published, the origin of this species was uncertain. It has been referred to the South American flora, but if our interpretation is correct it is a West Indian plant. It was introduced into cultivation in 1796.

This species is very common on flats or low hills and, so far as our observation goes, is never found very far inland in the Lesser Antilles.

Professor Schumann's description includes two species, one of which belongs here and one in the *Streptacanthae*, perhaps as Mr. Berger thinks to *O. amyclaea*—and a tall plant, 3.5 meters high, is now grown in Italy under that name. The Index Kewensis refers *O. triacantha* as a synonym of *O. curassavica*, which is erroneous if our interpretation of it is correct.

Plate XVIII, figure 3, represents joints of the plant collected on Antigua by Rose, Fitch, and Russell in 1913. Figure 140 is from a photograph taken on St. Christopher, British West Indies, by Paul G. Russell in 1913.

H. A. Wood del.

Opuntia jamaicensis.

1. Plant. 2, 3. Flower. 4. Longitudinal section of flower. 5, 6. Stamen. 7. Style.

An *Opuntia* collected by H. Pittier in Costa Rica and now growing in the cactus house of the U. S. Department of Agriculture has not been identified. It resembles somewhat *Opuntia triacantha*, but is much out of the range of that species and differs from it in some important respects. The joints are small, obovate to oblong, rounded at apex, dark green with purple blotches below the areoles, with low, broad tubercles; margin of the areole bearing short white hairs; spines usually wanting, but cultivated specimens bear a single short spine 6 to 7 mm. long from an areole.

FIG. 140.—Opuntia triacantha.

101. Opuntia jamaicensis Britton and Harris, Torreya 11: 130. 1911.

Erect, 1 meter high, with a short subcylindric trunk; branches several, ascending, joints dull green, obovate, much narrowed at base, flat, rather thin, readily detached, 7 to 13 cm. long, 5 to 7.5 cm. wide; areoles about 2.5 cm. apart; spines 1 to 5, usually only 2, acicular, unequal, white, 2.5 cm. long or less; flowers 4 cm. broad; petals 16 to 18; filaments greenish white; style white; stigma-lobes 7 or 8, creamy white; fruit pyriform, red, 3.5 to 4 cm. long; seeds 4 mm. broad.

Type locality: St. Catherine, Jamaica.

Distribution: Plain south of Spanish Town, Jamaica.

The following figures are from paintings by Miss H. A. Wood:

Plate XVIII, figure 4, shows a fruiting joint; figure 5 is of a section of the fruit; plate XIX, figure 1, shows the type plant about one-third natural size; figures 2, 3, and 4 are of the flowers; figures 5 and 6 show the stamens; figure 7 represents the style.

101*a*. Opuntia guatemalensis sp. nov. (See Appendix, p. 218.)

102. Opuntia tuna (Linnaeus) Miller, Gard. Dict. ed. 8. No. 3. 1769.

Cactus tuna Linnaeus, Sp. Pl. 468. 1753.
Cactus humilis Haworth, Misc. Nat. 187. 1803.
Opuntia humilis Haworth, Syn. Pl. Succ. 189. 1812.
Opuntia polyantha Haworth, Syn. Pl. Succ. 190. 1812.
Cactus polyanthos Sims, Curtis's Bot. Mag. 53: pl. 2691. 1826.
Opuntia multiflora Nicholson, Dict. Gard. 2: 503. 1885.

Plants 6 to 9 dm. high or less; joints usually small, but sometimes up to 16 cm. long, obovate to oblong, light green, except above the areoles and there brownish; leaves minute, fugacious; areoles arge; spines 2 to 6, usually only 3 to 5, slightly spreading, light yellow; glochids yellow; flowers about 5 cm. broad; sepals orbicular, yellowish, with a purple stripe along the center; petals light yellow,

slightly tinged with red, oblong, rounded at apex; filaments short, greenish below; style and stigma-lobes cream-colored or yellowish; ovary bright green, narrowed downward; fruit red, obovoid, about 3 cm. long; seeds 3 to 4 mm. broad.

Type locality: Jamaica.

Distribution: Southern side of Jamaica, West Indies.

Opuntia tuna is one of the old *Cactus* species. It was described by Linnaeus as *Cactus tuna* and by Philip Miller as *Opuntia tuna*. In the early part of the Nineteenth Century it was renamed *Opuntia humilis* and also *O. polyantha*, and has long passed under the latter name. *Opuntia tuna*, however, is one of the commonest *Opuntia* names in our botanical literature. This is due partly to the fact that the name was early transferred to *Opuntia dillenii*, one of the most common species, both wild and cultivated, and partly because tuna is the

FIG. 141.—Opuntia tuna.

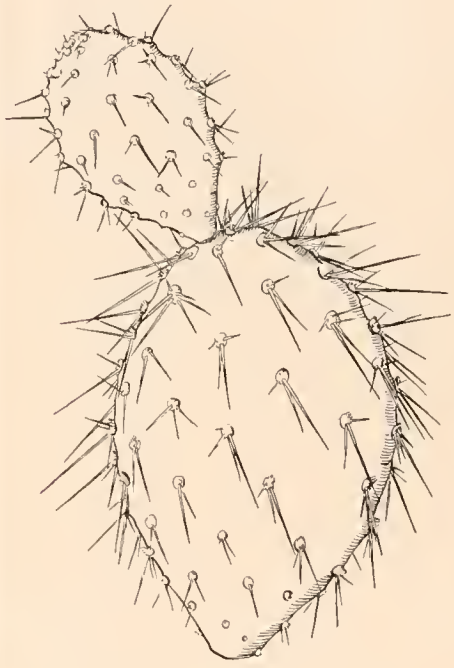


FIG. 142.—Opuntia tuna. ×0.5.

common Mexican name for opuntias, and many species have therefore been identified as *O. tuna*. So far as our studies indicate, this species is confined to the Jamaica lowlands.

Opuntia multiflora is referred here, although we do not know the plant. It is figured by Nicholson (Dict. Gard. Nicholson 2: f. 754); this figure is republished by Rümpler (Förster, Handb. Cact. ed. 2. f. 130), and by Knippel (Kakteen, pl. 28), both calling it *Opuntia polyantha;* while W. Watson (Cact. Cult. f. 79) uses the same illustration, calling it *O. dillenii*.

Opuntia coccinea (Pfeiffer, Enum. Cact. 161. 1837) is given as a synonym of *O. tuna*, but it was never published; it is doubtless different from *O. coccinea* Rafinesque (Med. Fl. U. S. 2: 247. 1830), also unpublished. The following names seem to belong here, but were not formally published: *Opuntia flexibilis* (Pfeiffer, Enum. Cact. 161. 1837); *O. tuna humilis* Salm-Dyck (Cact. Hort. Dyck. 1844. 46. 1845); *O. tuna lacvior* Salm-Dyck (Hort. Dyck. 186. 1834); and *O. tuna orbiculata* Salm-Dyck (Cact. Hort. Dyck. 1844. 47. 1845).

Illustrations: Loudon, Encycl. Pl. ed. 3. f. 6878, as *Cactus tuna;* Wiener Illustr. Gartenz. 10: f. 114, as *Opuntia humilis;* Blühende Kakteen 2: pl. 75; Förster, Handb. Cact.

ed. 2. f. 130; Knippel, Kakteen 2: pl. 28, these three as *Opuntia polyantha;* Curtis's Bot. Mag. 53: pl. 2691, as *Cactus polyanthos;* De Candolle, Pl. Succ. Hist. 2: pl. 138[d], as *Cactus opuntia polyanthos;* Descourtilz, Fl. Med. Antil. pl. 513, as *Cactus opuntia.*

Figure 141 is from a photograph of a plant collected by William Harris, near Kingston, Jamaica, in 1913; figure 142 represents a joint of the same plant.

102*a*. **Opuntia pennellii** sp. nov. (See Appendix, p. 219.)

103. **Opuntia antillana** Britton and Rose, Brooklyn Bot. Gard. Mem. 1: 74. 1918.

Growing in dense clumps, often 1 meter broad, more or less prostrate; joints usually obovate, 7 to 20 cm. long, narrow and nearly terete at base; terminal joints easily breaking off; leaves conic-subulate, about 2 mm. long; areoles large, 2 to 3 cm. apart, containing soft brown wool; spines stout, terete, 3 to 6 at an areole, unequal, 1 to 6 cm. long, yellow but becoming gray to nearly white in age; glochids numerous, yellow; flowers 5 to 7 cm. long; petals broad, obtuse, yellow, turning reddish in age; fruit reddish purple, 4 cm. long.

FIG. 143.—Opuntia antillana forming thickets.

Type locality: Near Basse Terre, St. Christopher, Rose, Fitch and Russell, No. 3230, February 2, 1913.

Distribution: St. Christopher, St. Croix, Tortola, St. Thomas, Porto Rico, and Hispaniola.

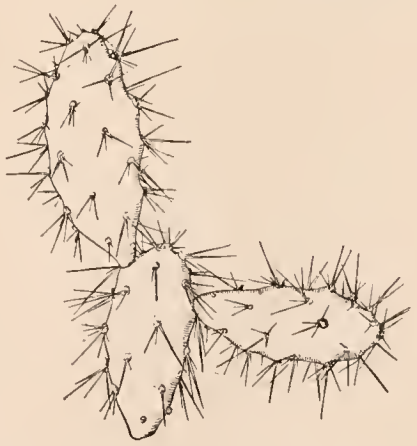


Fig. 144.—Opuntia antillana. ×0.33.

This species is one of the most widely distributed in the West Indies and, on some of the islands on which it occurs, generally the most abundant. This is partly due to the fact that the terminal joints are easily detached and may thus be widely scattered.

The question has frequently been raised in our minds whether this species may not be of hybrid origin. It has some resemblance to *O. dillenii,* but has much smaller joints and these very fragile. What the other parent would be is not so clear. The fragile joints would suggest *O. triacantha* or *O. repens,* but otherwise there is no close alliance with either of these. Owing to the fact that it is more common than any of these species, and is often not associated with any of them, we believe it to be distinct. In the

desert of Azua, Santo Domingo, this is the dominant cactus, forming dense, impenetrable thickets on the low coastal plain. In the wild state the Azua plant has the joints often bronzed or purple. On Tortola and St. Thomas it occurs with *O. dillenii* and *O. repens*, and is there called bull suckers.

Figure 143 is from a photograph taken by Paul G. Russell in 1913 near Azua, Santo Domingo; figure 144 represents joints of the type plant.

103*a*. **Opuntia caracasana** Salm-Dyck. (See Appendix, p. 219.)

104. **Opuntia wentiana** sp. nov.

Opuntia tunoides Britton and Shafer in Boldingh, Fl. Ned. W. Ind. Eiland 300. 1913. Not *O. tunoidea* Gibbes.

Plant erect, much branched, 1 to 2 meters high; joints obovate to elliptic, rather thin, up to 25 cm. long, usually rounded at apex, pale green, slightly glaucous; terminal joints somewhat fragile; leaves small and subulate; spines on young joints usually 3, afterwards 4 or 5, when young pale yellow but soon white; flowers small, 6 to 7 cm. long including the ovary; petals pale yellow, 3 cm. long, obovate, acute; style cream-colored; fruit small, red.

Type locality: Curaçao.

Distribution: Venezuela, and the neighboring islands, Margarita, Bonaire, Curaçao, and Aruba.

Dr. Rose found this plant repeatedly in Venezuela and writes of it as follows: Very common not only on the savannas along the coast but also on the neighboring hills along with *Lemaireocereus*, *Cephalocereus*, and other cactus genera; its more or less fragile joints, yellowish spines, bushy stature, and structure of flowers ally it with the *Tunae*.

This species has been confused with the Jamaican *Opuntia tuna* (Linnaeus) Miller, which it resembles. Named in honor of Professor F. A. F. C. Went, distinguished Dutch botanist.

104*a*. **Opuntia aequatorialis** sp. nov. (See Appendix, p. 219.)

105. **Opuntia decumbens** Salm-Dyck, Hort. Dyck. 361. 1834.

Opuntia puberula Pfeiffer, Enum. Cact. 156. 1837.

Stems low, often creeping or trailing, rarely over 4 dm. high; joints 1 to 2 dm. long, oval to oblong, covered with a short, soft pubescence; areole usually small, surrounded by a purple blotch, bearing yellow glochids and wool, the wool cobweb-like on very young joints; spines often wanting, usually solitary but sometimes numerous, slender or rather stout, 4 cm. long and yellow; flowers numerous, small, including the ovary about 4 cm. long; petals dark yellow; fruit deep purple, very juicy; seeds about 4 mm. broad.

Type locality: In Mexico.

Distribution: Guatemala and Mexico as far north as Mazatlan and Tamaulipas.

Opuntia repens Karwinsky (Salm-Dyck, Hort. Dyck. 361. 1834) and *O. irrorata* Martius are usually given as synonyms of this species, but as they were printed without descriptions, they should hardly be referred to synonymy.

The species has long been in cultivation, a colored illustration having been published in Curtis's Botanical Magazine in 1841. It grows luxuriously in greenhouses, flowering profusely in the spring.

We have referred here *Opuntia puberula* Pfeiffer, which seems to be different from the plant now grown in collections under that name. Pfeiffer's original description, based upon sterile plants alone, may be paraphrased as follows: Joints thick, obovate, 7.5 to 12.5 cm. long by 5 to 7.5 cm. broad, puberulent, green; areoles somewhat remote, each surrounded by a red spot, bearing in the upper part a bunch of short glochids and below 2 to 4 slender, white, divergent spines, the longer ones 8 mm. long; leaves 4 mm. long, acute, red at apex.

Labouret's description of 1853, of *O. puberula* Pfeiffer, is very similar to Pfeiffer's, except that he states that the spines are 9 cm. long. Both these descriptions answer very

M. E. Eaton del.

1, 2. Flowering and fruiting joints of *Opuntia decumbens*. 3. Probable hybrid, with fruit and flower. (All natural size.)

well to the plant which we know as *Opuntia decumbens*, originally described from plants growing in the Botanical Garden in Vienna.

Opuntia decumbens irrorata Forbes (Hort. Tour. Germ. 158. 1837) is doubtless the same as *O. irrorata* Martius (Pfeiffer, Enum. Cact. 154. 1837). These and *O. decumbens longispina* Salm-Dyck (Haage and Schmidt, Haupt-Verzeichnis 1912: 230. 1912) presumably belong here.

Opuntia parvispina Salm-Dyck (Cact. Hort. Dyck. 1849. 238. 1850), described from garden specimens of unknown origin, without flowers, has never been definitely placed. Schumann lists it among his unknown species, but attributes it to Mexico. Salm-Dyck states that it resembles *O. puberula*, but that it is glabrous.

Illustrations: Curtis's Bot. Mag. 68: pl. 3914; Blühende Kakteen 3: pl. 132.

FIG. 145.—Opuntia decumbens.

Plate XX, figure 1, represents a flowering joint of a plant collected by Dr. MacDougal and Dr. Rose at Tehuacán, Mexico, in 1906; figure 2 represents a fruiting joint of a plant collected by William R. Maxon at El Rancho, Guatemala, in 1905. Figure 145 is from a photograph of the plant taken at Tomellín, Mexico, by Dr. MacDougal in 1906.

106. Opuntia depressa Rose, Smiths. Misc. Coll. 50: 517. 1908.

Low, creeping or spreading plant, sometimes 60 cm. high and forming a patch 3 to 4 meters in diameter; joints of a dark glossy yellowish green color, pubescent, when young, obovate, 20 cm. long, usually with 1 long, somewhat curved spine at each areole, sometimes with 1 to 3 shorter ones, all yellowish; old joints oblong, 30 cm. long, bearing 4 to 6 spines at each areole; flowers red; fruit small, globular, with large clusters of brown glochids, when immature with a broad, deep umbilicus.

Type locality: Near Tehuacán, Mexico.

Distribution: Southern Mexico.

This plant is very common about Tehuacán, growing with species of *Agave*, *Beaucarnea*, and *Echinocactus*.

Figure 146 is from a photograph taken by Dr. MacDougal of the type plant.

FIG. 146.—Opuntia depressa, in the foreground.

Series 5. BASILARES.

We recognize eight species as forming this series. They are low or bushy, much branched plants, with flat, thin, broad joints, the areoles small, usually numerous and close together.

KEY TO SPECIES.

Joints papillose, not pubescent.
- Fruit juicy, red ..... 107. *O. lubrica*
- Fruit dry or nearly dry ..... 108. *O. treleasei*

Joints mostly manifestly pubescent.
- Spines none or few.
  - Flowers red ..... 109. *O. basilaris*
  - Flowers yellow to orange.
    - Joints bright green.
      - Glochids long ..... 110. *O. microdasys*
      - Glochids short ..... 111. *O. macrocalyx*
    - Joints grayish green ..... 112. *O. rufida*
- Spines very numerous.
  - Areoles close together ..... 113. *O. pycnantha*
  - Areoles distant ..... 114. *O. comonduensis*

107. Opuntia lubrica Griffiths, Rep. Mo. Bot. Gard. **21**: 169. 1910.

"A low ascending, spreading species very similar in habit to *O. microdasys*, frequently 4½ dm. high and when well developed 10 dm. or more in diameter; joints sub-circular to obovate, about 15 by 20 cm., or in case of last joints of previous year about 12 by 15 cm., bright, glossy, leaf-green, very evidently papillate but scarcely pubescent under a lens; leaves subulate, cuspidate-pointed, 6 to 9 mm. in length; areoles 15 to 22 mm. apart, 4 to 6 mm. in diameter, sub-circular, prominent; spicules prominent, 4 to 5 mm. in length, erect, bushy, in crescentic tufts in upper portion of areoles, becoming much more numerous in age, and at 2 to 4 years completely filling the areole, and, like *O. rufida* and some other species, becoming very abundant and conspicuous by proliferation of areolar tissue into short raised or columnar structures; spines exceedingly variable, sometimes nearly absent, again quite abundant and irregularly distributed, none to many, mostly 1 to 3, becoming more numerous with age and in scattering areoles to as high as 16, mostly about 12 mm. long, but sometimes 2½ cm., yellowish, translucent, bonelike, sometimes darker at base; fruits decidedly acid, light red without with yellowish green rind and red pulp; seed small, thin shelled, about 3 mm. in diameter."

Type locality: Near Alonzo, Mexico.
Distribution: Known only from the type locality.

Our examination of a painting of this plant in the collection made by Dr. Griffiths showed it to have great similarity to *Opuntia rufida*.

Illustration: Rep. Mo. Bot. Gard. 21: pl. 23.

Figure 147 is copied from the illustration above cited.

108. Opuntia treleasei Coulter, Contr. U. S. Nat. Herb. 3: 434. 1896.

Opuntia basilaris treleasei Toumey, Cycl. Amer. Hort. Bailey 3: 1147. 1901.

Opuntia treleasei kernii Griffiths and Hare, N. Mex. Agr. Exp. Sta. Bull. 60: 81. 1906.

Low, sometimes 3 dm. high, spreading at base, some of the branches of 2 to 4 erect joints; joints obovate, 15 cm. long or more, fleshy, pale bluish green, glabrous, terete at base; areoles numerous, filled with dirty yellow glochids, usually without spines, sometimes quite spiny; flowers rose-colored; fruit dry, subglobose, with large areoles filled with glochids and sometimes bearing spines; seeds large, turgid, 7 cm. in diameter.

Type locality: Caliente, in the Tehachapi Mountains, California.

Distribution: Southern California.

Figure 148 is from a photograph of the plant growing on the mesa southeast of Bakersfield, California, taken by Dr. MacDougal in 1913.

109. Opuntia basilaris Engelmann and Bigelow, Proc. Amer. Acad. 3: 298. 1856.

Opuntia basilaris ramosa Parish, Bull. Torr. Club 19: 92. 1892.

Opuntia intricata Griffiths, Proc. Biol. Soc. Washington 29: 10. 1916.

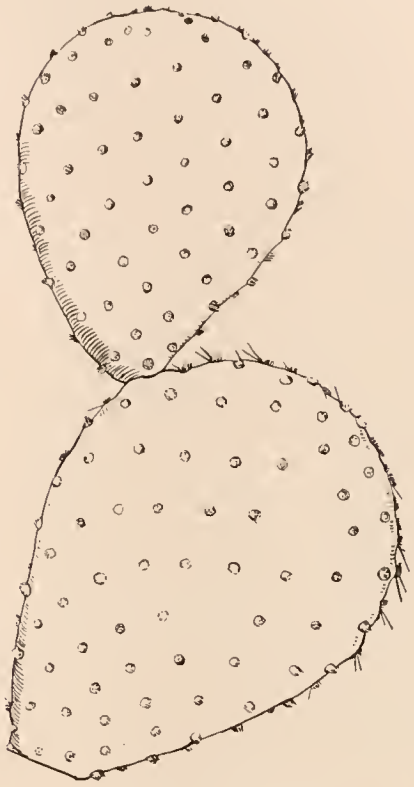


FIG. 147.—Opuntia lubrica.

FIG. 148.—Opuntia treleasei, Southern California.

Stems low, growing in clumps, either prostrate or erect, sometimes 12 dm. high; joints broadly obovate, 8 to 20 cm. long, slightly pubescent or glabrous, usually highly colored; leaves 2 to 5 mm. long, subulate; areoles numerous, filled with white to brown wool and brownish glochids; spines none or rarely a few at upper areoles; flowers large, 6 to 8 cm. long, deep purple or sometimes white; filaments purple; fruit dry, globular to obovoid; seeds large, thick, 6 to 10 mm. broad.

Type locality: From Cactus Pass down the valley of the Bill Williams River.

Distribution: Northern Sonora, western Arizona, southern California, Nevada, and southern Utah.

This is a variable species as to habit, size, pubescence, and color of flowers. The variety *ramosa* described by Mr. Parish is more erect than the ordinary form and glabrous. It has large, handsome flowers, and is a splendid plant for outdoor cultivation where the climate is suitable, but does not live long in greenhouses. It is called beaver-tail in Arizona.

Opuntia humistrata Griffiths (Bull. Torr. Club 43: 83. 1916) we refer here from the description; it is said to differ from *O. basilaris* "by its much smaller as well as different shaped joints"; it was found in the San Bernardino Mountains, northern California, within the range of *O. basilaris*.

The following varieties are listed, but have not been described: *albiflora*, *coerulea*, *nana*, and *pfersdorffii*.

Opuntia basilaris cordata is a garden plant briefly described by F. Forbes (Monatsschr. Kakteenk. 16: 46. 1906), of which we have seen no specimens.

Illustrations: Cact. Journ. 1: 167; Dict. Gard. Nicholson 2: f. 750; Förster, Handb. Cact. ed. 2. f. 129; Pac. R. Rep. 4: pl. 13, f. 1 to 5; pl. 23, f. 14; Rümpler, Sukkulenten f. 123; W. Watson, Cact. Cult. f. 76; Cact. Journ. 1: pl. October, as *Opuntia basilaris* var. *cristata* and var. *nevadensis;* Alverson, Cact. Cat. frontispiece, as *Opuntia basilaris albiflora*.

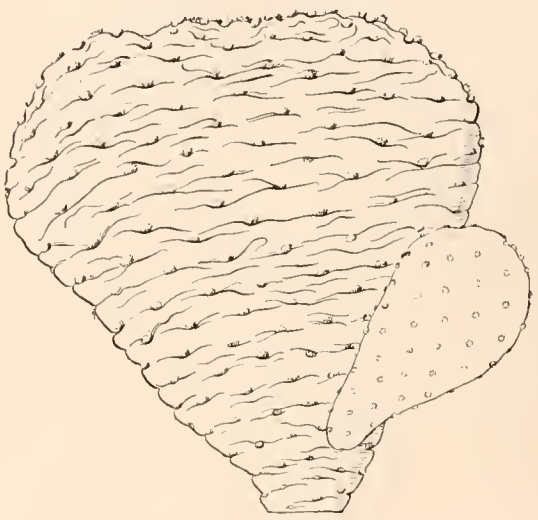


Fig. 149.—Opuntia basilaris.

Figure 149 is copied from Pac. R. Rep. 4: pl. 13, f. 1, an illustration cited above.

Opuntia brachyclada Griffiths (Proc. Biol. Soc. Washington 27: 25. 1914) is an anomalous plant with some of the joints terete and others somewhat flattened. It has been suggested that it is a hybrid between a cylindric and a flat-jointed species; but, so far as we know, natural hybrids do not occur between species of these subgenera. It is more likely to be an anomalous form of *Opuntia basilaris*, a form of which is known in the same mountains where it was found.

110. Opuntia microdasys (Lehmann) Pfeiffer, Enum. Cact. 154. 1837.

Cactus microdasys Lehmann, Ind. Sem. Hamburg. 16. 1827.
Opuntia pulvinata De Candolle, Mém. Mus. Hist. Nat. Paris 17: 119. 1828.
Opuntia microdasys minor Salm-Dyck, Hort. Dyck. 186. 1834.
Opuntia microdasys laevior Salm-Dyck, Cact. Hort. Dyck. 1849. 241. 1850.

Often low and creeping but sometimes nearly erect and 4 to 6 dm. high; joints oblong to orbicular, 10 to 15 cm. long, soft-velvety, usually pale green, spineless; areoles conspicuous, closely set, filled with numerous yellow or brown glochids; flowers usually produced in abundance, 4 to 5 cm. long, pure yellow or tinged with red; sepals acuminate; petals broad, retuse; filaments and style white; stigma-lobes 6 to 8, green; fruit dark red, juicy, nearly globular; seeds small, 2 to 3 mm. broad.

Type locality: In Mexico, but originally stated by Lehmann as coming from Brazil.

Distribution: Northern Mexico.

In spite of its troublesome glochids, which easily become detached, this species has long been a greenhouse favorite. No cactus collection, however small, lacks one or more pots of this species, which rarely grows large in cultivation.

Opuntia microdasys is usually credited to Lehmann, but he apparently published it as *Cactus microdasys*, and this is the way it is cited in the Index Kewensis. Lehmann soon republished this species (Nov. Act. Nat. Cur. 16: 317) where it appears as *Cactus (Opuntia) microdasys*. The first use of the name of *Opuntia microdasys* was by Salm-Dyck (Hort. Dyck. 186) in 1834, but was without description or synonymy. Pfeiffer in 1837, however, republishes Lehmann's description under *Opuntia* and is therefore cited as the author of the binomial. Here it is first credited to Mexico, although Lehmann stated definitely that it comes from Brazil; this he does also with regard to *Opuntia tunicata* and *Cactus bradypus*, both Mexican species, while

Fig. 150.—Opuntia microdasys.

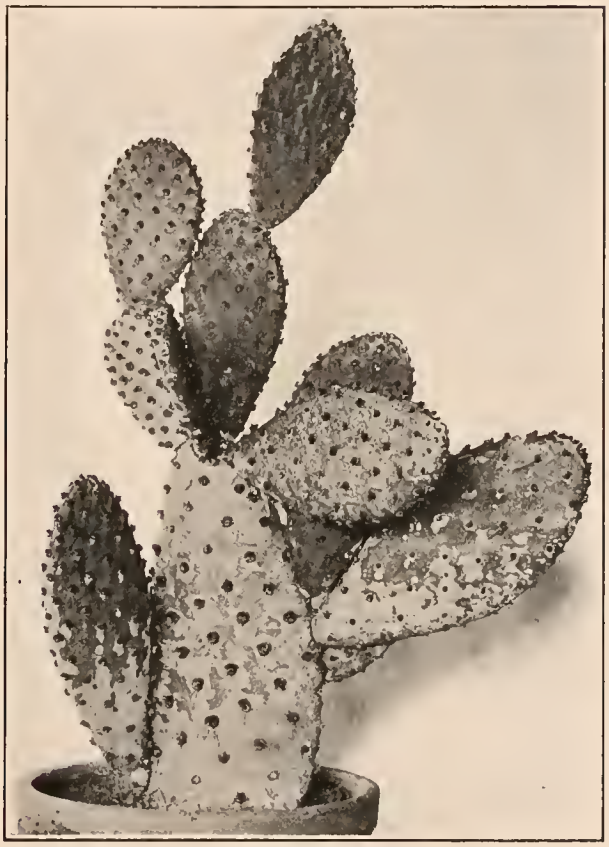


Fig. 151.—Opuntia, probable hybrid.

Cactus linkii and *C. ottonis*, both credited to Mexico, are known only from South America. If this *Opuntia* really came originally from Brazil, it might very well be the same as *Opuntia inamoena*.

As shown above (p. 116), *Opuntia puberula* is referred to *O. decumbens*. The *O. puberula* of our gardens, however, is quite a different plant, and in all probability is of hybrid origin. It is almost identical with a hybrid between *O. microdasys* and *O. cantabrigiensis* which Dr. Rose collected in Hidalgo, Mexico, in 1905, and which is now grown in the collection in Washington and in the New York Botanical Garden.

Illustrations: Agr. Gaz. N. S. W. 25: pl. opp. p. 138; p. 138; Gard. Chron. III. 30: f. 76; Rep. Mo. Bot. Gard. 19: pl. 28, in part; 20: pl. 12, in part; Safford, Ann. Rep. Smiths. Inst. 1908: pl. 10, f. 4; U. S. Dept. Agr. Bur. Pl. Ind. Bull. 262: pl. 5, f. 2.

Plate XXII, figure 1, represents joints of the plant grown in a garden at Riverside, California, received by Dr. Rose in 1905. Figure 150 is from a photograph taken by Professor F. E. Lloyd in Zacatecas, Mexico, in 1908.

Plate XX, figure 3, shows a flowering joint of a plant sent to the New York Botanical Garden by M. Simon, of St. Ouen, Paris, France, in 1901, as *Opuntia puberula*. Figure 151 is from a photograph of the plant sent from La Mortola, Italy, to the same institution in 1912, as *Opuntia puberula*.

111. Opuntia macrocalyx Griffiths, Rep. Mo. Bot. Gard. **19**: 268. 1908.

"A profusely, divaricately branched, ascending or erect, spreading plant, 9 to 10 dm. high and about the same in diameter; joints long-obovate, variable but commonly 9 by 22 cm. for last year's growth, gray green, pubescent, velvety to the touch; areoles subcircular, usually 2 to 3 mm. in diameter, very close to 1 cm. apart, slightly sunken; wool tawny, prominent, as long as spicules and occupying lower half of areole; spicules reddish brown, about 1 mm. long, occupying upper half of areole, easily separable and causing fully as much annoyance in handling as those of *O. microdasys*, in age often appearing dirty yellow *in situ* but distinctly reddish brown when removed; strictly spineless; flowers yellow, green outwardly, the leaves on ovary very long subulate and changing gradually into the sepals which are very long subulate, delicately pointed, loosely arranged or often half recurved at apex, giving to the bud a rather ragged appearance; fruit red but both pulp and rind greenish, long obovate to cylindrical, about 2 by 7 cm., with but few rather small seeds, about 3 mm. in diameter."

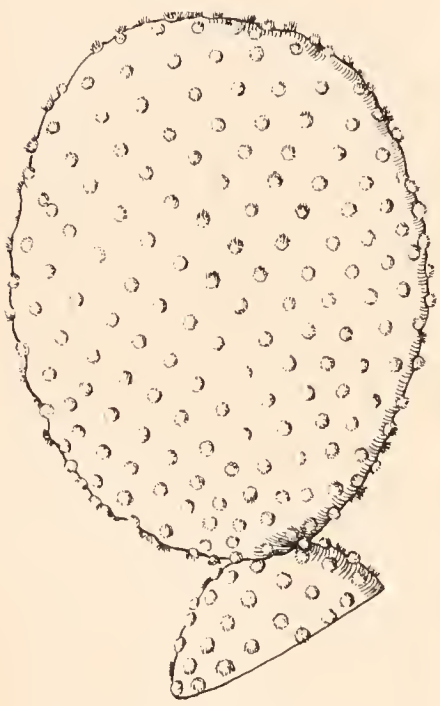


FIG. 152.—Opuntia macrocalyx. ×0.75.

FIG. 153.—Opuntia rufida.

Type locality: In cultivation at Riverside, California.

Distribution: Known only from cultivated plants; perhaps also from Coahuila, Mexico.

Illustration: Rep. Mo. Bot. Gard. **19**: pl. 28, in part.

Figure 152 is drawn from a joint of the plant collected by Edward Palmer at Saltillo, Mexico, in 1904.

112. Opuntia rufida Engelmann, Proc. Amer. Acad. **3**: 298. 1856.

Opuntia microdasys rufida Schumann, Gesamtb. Kakteen 706. 1898.

More or less erect, 2 to 15 dm. high, with a somewhat definite trunk; joints nearly orbicular, 6 to 25 cm. in diameter, thickish, velvety-tomentose, dull grayish green; leaves subulate, caducous, 4 to 6 cm. long, green with reddish tips; areoles large, filled with numerous brown glochids; flowers

yellow to orange, 4 to 5 cm. long including the ovary; petals obovate, 2 to 2.5 cm. long; filaments greenish white, short, 1 cm. long; style 1.5 cm. long, thick, bulbous just above the base; stigma-lobes 5, deep green; ovary globular, 1.5 cm. in diameter, umbilicate, with large areoles; fruit, according to field observation of Dr. Griffiths, bright red.

Type locality: About Presidio del Norte, on the Rio Grande.

Distribution: Texas and northern Mexico.

This species seems much less common than *O. microdasys*, with which it is often confused. The joints are gray or bluish green, and the glochids are brown. It does fairly well under greenhouse conditions.

Illustration: Rep. Mo. Bot. Gard. 20: pl. 3; Carnegie Inst. Wash. 269: pl. 11, f. 94.

Figure 153 is from a photograph of a plant brought from Mexico for the New York Botanical Garden in 1896 by Mrs. N. L. Britton.

FIG. 154.—Opuntia pycnantha. Along the coastal plain of Lower California.

113. Opuntia pycnantha Engelmann in Coulter, Contr. U. S. Nat. Herb. 3: 423. 1896.

Opuntia pycnantha margaritana Coulter, Contr. U. S. Nat. Herb. 3: 424. 1896.

Often low and creeping, but sometimes forming a clump 2 dm. high; joints oblong to orbicular, often 20 cm. long, puberulent or papillose, usually nearly hidden by the thick mass of spines; areoles large and closely set, the upper part filled with yellow or brown glochids, and the lower part with 8 to 12 yellow or brown reflexed spines 2 to 3 cm. long; leaves and flowers unknown; fruit 4 cm. long, very spiny; seeds 2 cm. broad, very thick.

Type locality: Magdalena Bay, Lower California.

Distribution: Southern Lower California.

Coulter's variety *margaritana* is known only from Margarita Island, while the species proper is known only from an adjacent island, Magdalena. They differ only in the color of their spines and glochids. Both have been in cultivation in New York City and Washington, but are not well suited for indoor plants.

This species grows in one of the driest parts of Lower California on islands where there is no surface water and where there is no rain sometimes for five or six years.

Figure 154 is from a photograph taken by Dr. Rose near Santa Maria Bay, Magdalena Island, Lower California, in 1911.

114. Opuntia comonduensis (Coulter) Britton and Rose, Smiths. Misc. Coll. 50: 519. 1908.

Opuntia angustata comonduensis Coulter, Contr. U. S. Nat. Herb. 3: 425. 1896.

Low, spreading plants, sometimes 2 dm. high and forming broad clumps; joints obovate to orbicular, 12 to 15 cm. long, softly pubescent; areoles large, filled with brown wool and yellow glochids; lower areoles spineless, the upper ones bearing 1 or 2, rarely 3, or on old stems as many as 10, slender spines, 3 to 5 cm. long or longer, yellow; flowers, including ovary, 6 cm. long, yellow; fruit purple, 4 cm. long, spineless; seeds 4 to 4.5 mm. broad, thick.

Type locality: Comondu, Lower California.

Distribution: Southern Lower California.

As was pointed out by Mrs. K. Brandegee, this plant is not closely related to *Opuntia angustata*.

FIG. 155.—Opuntia comonduensis.

This species has long been known only from herbarium specimens collected by Mr. Brandegee in 1889. In 1911 Dr. Rose collected considerable material both near the town of San José and on Carmen Island which has since been in cultivation in the New York Botanical Garden and in Washington. The above description is based largely on this collection.

This species sometimes grows with *O. tapona*, in fact being confused in the original material; except for its pubescent joints, they are not readily distinguished.

Figure 155 is from a photograph by Mr. T. W. Smillie of a plant collected by Mr. E. W. Nelson and Mr. E. A. Goldman in Lower California in 1906.

FIG. 156.—Opuntia inamoena. A single plant. Photograph by P. H. Dorsett.

Series 6. INAMOENAE.

A single, prostrate or depressed, usually spineless, light-green Brazilian species.

115. **Opuntia inamoena** Schumann in Martius, Fl. Bras. 4[2]: 306. 1890.

Opuntia quipa Weber, Dict. Hort. Bois 894. 1898.

Usually low, often prostrate, forming clumps 2 to 10 dm. broad, or sometimes in sheltered situations 6 cm. high and forming dense, extensive thickets; roots fibrous; joints bluish green, when young bright green, orbicular to oblong, 8 to 16 cm. long, usually quite thick, sometimes 3 cm. thick, usually quite spineless; leaves minute, 2 mm. long; areoles small, when young filled with numerous yellowish-brown glochids; glochids unequal, spreading, easily becoming detached; flowers small, brick-red; petals spreading; filaments orange; style yellow; stigma-lobes pale green; fruit globular, yellowish, 2.5 to 3 cm. in diameter.

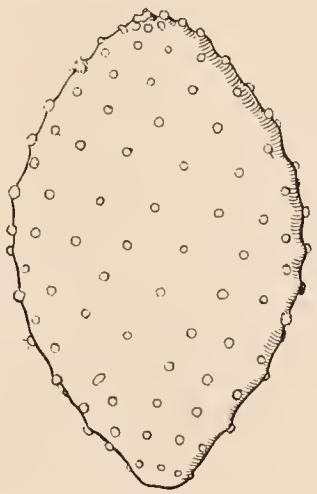


FIG. 157.—Opuntia inamoena. ×0.66.

Type locality: Schumann cites Rio de Janeiro in original description.

Distribution: Pernambuco, Bahia, and Minas Geraes, Brazil.

This plant is known as quipa in Bahia, Brazil.

This species is very common in all the dry part of Bahia and, although abundant and mostly spineless, is avoided by all kinds of grazing animals, even when the country is devoid of other suitable forage. It has been suggested that the plant may be bitter, or that the glochids are troublesome; the glochids, however, are usually wanting on old joints.

The plant rarely develops acicular spines up to 3 cm. long on some joints, as shown by specimens collected by Dr. Rose and Mr. Russell near Machado Portello, Brazil.

Figure 156 is from a photograph taken by Mr. P. H. Dorsett near Joazeiro, Brazil, in 1914; figure 157 is from a plant collected by Dr. Rose near Machado Portello, Bahia, Brazil, in 1915.

Series 7. TORTISPINAE.

Prostrate or spreading plants rarely erect, with mostly rather small, persistent, scarcely tuberculate, orbicular or oval joints, and large flowers; natives of the eastern, central, and southern United States.

Plate 21 represents a group of hardy cacti, chiefly species of this series, at the New York Botanical Garden.

KEY TO SPECIES.

Spines none or only 1 or 2 at an areole.
- Joints bluish green; at least when young; roots tuber-like.
  - Fruit clavate; joints thin.
    - Fruit about 4.5 cm. long ..... 116. *O. allairei*
    - Fruit 5 to 7 cm. long ..... 116*a*. *O. lata*
  - Fruit obovoid; joints turgid ..... 117. *O. pollardii*
- Joints green; roots not tuberous.
  - Flowers 8 cm. broad or less.
    - Joints orbicular or little longer than wide ..... 118. *O. opuntia*
    - Joints oblong, much longer than wide ..... 119. *O. macrarthra*
  - Flowers 10 to 12 cm. broad ..... 120. *O. grandiflora*

Spines mostly 2 or more at an areole.
- Ovary obconic, 2 to 4 cm. long.
  - Roots tuberous.
    - Joints repand; plant suberect ..... 121. *O. austrina*
    - Joints scarcely repand; plants nearly prostrate ..... 122. *O. macrorhiza*
  - Roots not tuberous.
    - Flowers and fruit small ..... 123. *O. plumbea*
    - Flowers and fruit large.
      - Spines white to light brown, slender.
        - Seeds acute-margined ..... 124. *O. tortispina*
        - Seeds obtuse-margined.
          - Fruit large, 4 to 5 cm. long; spines light colored ..... 125. *O. stenochila*
          - Fruit small, 2 to 3 cm. long; spines brown ..... 126. *O. delicata*
      - Spines dark brown, stout ..... 127. *O. fuscoatra*
- Ovary narrowly subcylindric, 5 to 6 cm. long ..... 127*a*. *O. macateei*

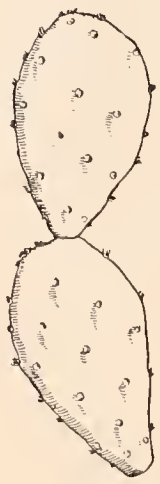


FIG. 158.—Opuntia allairei. ×0.66.

116. Opuntia allairei Griffiths, Rep. Mo. Bot. Gard. 20: 83. 1909.

A low, spreading, tuberous-rooted, prostrate plant, with some of the joints ascending; joints bluish green, obovate, usually 10 to 15 cm. long, originally described as even longer, with or without spines; spines, if present, 1 to 3, yellowish brown, 2.5 cm. long or less, slender but a little flattened; glochids numerous, especially abundant at very old areoles, yellow; leaves 6 to 8 mm. long; flowers 6 to 7 cm. broad, yellow with a red center; fruit 4 to 5 cm. long, dark red.

Type locality: Mouth of Trinity River, Texas.

Distribution: Southern Texas and western Louisiana.

This species is perhaps nearest *O. macrorhiza*, but differs in the usual absence of spines and in differently colored joints.

Illustrations: Rep. Mo. Bot. Gard. 20: pl. 2, f. 2; pl. 5; pl. 12, in part.

Figure 158 is copied from the second illustration above cited.

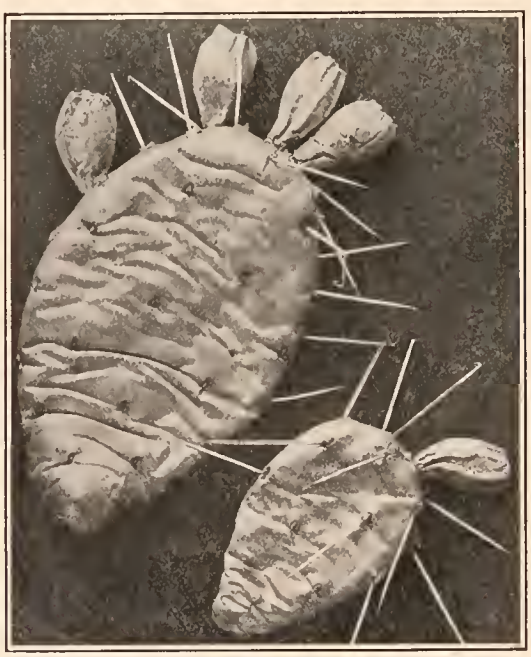


FIG. 159.—Opuntia pollardii. ×0.4.

116*a*. Opuntia lata Small, Journ. N. Y. Bot. Gard. 20: 26. 1919. (See Appendix, p. 220.)

117. Opuntia pollardii Britton and Rose, Smiths. Misc. Coll. 50: 523. 1908.

Prostrate, tuberiferous, related to *Opuntia opuntia;* young joints bluish green, glaucous, 5 to 16 cm. long, 1 to 2 cm. thick; areoles 1.5 to 3 cm. apart, bearing numerous yellow glochids 2 to 3 cm.

Group of hardy prickly pears, mostly *Opuntia tortispina*, in the herbaceous grounds of the New York Botanical Garden.

long, those toward the top of the joint each with a single stout, stiff, pungent spine 2.5 to 4 cm. long; fruit short-obovoid, 2.5 cm. long, 1.5 cm. thick, with a few areoles bearing tufts of brownish wool but no spines and but few glochids; flowers yellow, 6 to 8 cm. broad; sepals deltoid to rhombic; fruit 2.5 to 4 cm. long; seeds 4 to 6 mm. wide, much thicker than those of *Opuntia opuntia*.

Type locality: Biloxi, Harrison County, Mississippi.

Distribution: Coastal plain, Church Island, North Carolina, to northern Florida, Alabama, and Mississippi.

Figure 159 is from a photograph of fruiting joints collected by A. H. Howell on Petit Bois Island, Alabama.

118. Opuntia opuntia (Linnaeus) Karsten, Deutsch. Fl. 888. 1882.

Cactus opuntia Linnaeus, Sp. Pl. 468. 1753.
Cactus compressus Salisbury, Prodr. 348. 1796.
Cactus opuntia nana De Candolle, Pl. Succ. Hist. **2**: pl. 138. [A]. 1799.
Cactus humifusus Rafinesque, Ann. Nat. 15. 1820.
Opuntia vulgaris major Salm-Dyck, Observ. Bot. **3**: 9. 1822.
*Opuntia vulgaris media** Salm-Dyck, Observ. Bot. **3**: 9. 1822.
Opuntia humifusa Rafinesque, Med. Fl. U. S. **2**: 247. 1830.
Opuntia mesacantha Rafinesque, Bull. Bot. Seringe 216. 1830.
Opuntia caespitosa Rafinesque, Bull. Bot. Seringe 216. 1830.
Opuntia intermedia Salm-Dyck, Hort. Dyck. 364. 1834.
Opuntia nana Visiani, Fl. Dalmatica **3**: 143. 1852.
Opuntia rafinesquei† Engelmann, Proc. Amer. Acad. **3**: 295. 1856.
Opuntia rafinesquei microsperma Engelmann, Proc. Amer. Acad. **3**: 295. 1856.
Opuntia rafinesquei minor Engelmann and Bigelow, Pac. R. Rep. **4**: 55. 1856.
Opuntia vulgaris rafinesquei Gray, Man. Bot. ed. 2. 136. 1856.
Opuntia rafinesquei arkansana Rümpler in Förster, Handb. Cact. ed. 2. 922. 1885.
Opuntia mesacantha microsperma Coulter, Contr. U. S. Nat. Herb. **3**: 429. 1896.
Opuntia mesacantha parva Coulter, Contr. U. S. Nat. Herb. **3**: 429. 1896.
Opuntia vulgaris nana Schumann, Gesamtb. Kakteen 715. 1898.
Opuntia humifusa microsperma Heller, Cat. N. Amer. Pl. ed. 2. 8. 1900.
Opuntia humifusa parva Heller, Cat. N. Amer. Pl. ed. 2. 8. 1900.

Low, spreading plants, sometimes ascending, with fibrous roots; joints orbicular to oblong, 3 to 13 cm. long, rarely longer, thick, dark green; areoles usually far apart; leaves subulate, appressed or spreading, 4 to 8 mm. long, early deciduous; spines often wanting, when present usually one from an areole, rarely two, 5 cm. long or less, brownish or sometimes nearly white, but on seedlings 5 to 12; glochids numerous, yellow to dark brown; flowers usually bright yellow, sometimes with reddish centers, 5 to 8.5 cm. broad; petals 8 to 10, widely spreading; filaments yellow; stigma-lobes white; fruit obovoid to oblong, red, juicy, 2.5 to 5 cm. long, edible; seeds 4 to 5 mm. broad.

Type locality: In Virginia.

Distribution: Sandy and rocky places from Massachusetts to Virginia, the mountains of Georgia and central Alabama extending north into southern Ontario, Canada (Point Pelee), west in isolated colonies to northern Illinois, eastern Missouri and Tennessee, and long established in the mountains of northern Italy and Switzerland.

Linnaeus undoubtedly had two species in his *Cactus opuntia*, one being the low Virginia plant commonly known as *O. vulgaris*, and the other a tall, branching plant figured by Bauhin (p. 154). Upon Bauhin's illustration Miller based his *Opuntia vulgaris*, a name which was afterwards transferred to the low, procumbent plant of the eastern United States. For this reason Burkill (Rec. Bot. Surv. India 4: 288. 1911) would displace the name *O. vulgaris* and take up the name *O. nana*. We are quite in agreement with him as to the *O. vulgaris* Miller, but we retain for the low plant the specific name *opuntia* Linnaeus. The tall species is *O. monacantha*, which we now call *O. vulgaris*, as suggested by Burkill.

It is to be noted that the southern Atlantic coast specimens of *Opuntia opuntia* have yellow or greenish-yellow glochids, while those in its northern and western range have brown glochids. Its southwestern limit is uncertain. It probably does not extend to Texas, although two varieties have been reported from there; these we are disposed to treat as species under the names *Opuntia macrorhiza* and *O. grandiflora*. It is reported from

Opuntia vulgaris minor (Labouret, Monogr. Cact. 476. 1853) was doubtless intended for this name.
†Sometimes spelled *rafinesquiana*.

eastern Kansas, but the plants found there are not like those found in Illinois and Indiana, having more spines and a glaucous bloom, and are tuberous-rooted, and these are referred by us to *O. macrorhiza*. The published western varieties of *O. humifusa* are specifically distinct; we have referred them to *O. tortispina*.

Some of the joints of this plant elongate under shade conditions, reaching at least 2.5 dm. in length and not more than 5 cm. in width.

Opuntia arkansana (Hirscht, Monatsschr. Kakteenk. 8: 115. 1898) has not been formally described. The name should doubtless be referred here.

Opuntia prostrata Monville and Lemaire (Förster, Handb. Cact. 478. 1846) was given only as a synonym of *O. intermedia*, while *O. intermedia prostrata* Salm-Dyck (Cact. Hort. Dyck 1849. 69. 1850) was based on *O. prostrata*.

O. rafinesquei parva Haage and Schmidt (Verzeichnis Blumenzwiebeln 1915: 29. 1915) is a new name for *O. mesacantha parva* Coulter.

Under *Opuntia vulgaris* Michaele Gandoger in his Flora Europea (9: 145. 1886) has proposed the following new binomials: *O. recedens*, *O. morisii*, *O. cycloidea*, *O. inaequalis*, *O. ligustica*, and *O. mediterranea*. The following varieties cited under *O. humifusa* are in the trade: *cymochila*, *greenei*, *macrorhiza*, *oplocarpa* and *stenochila* (Stand. Cycl. Hort. Bailey 4: 2363. 1916.)

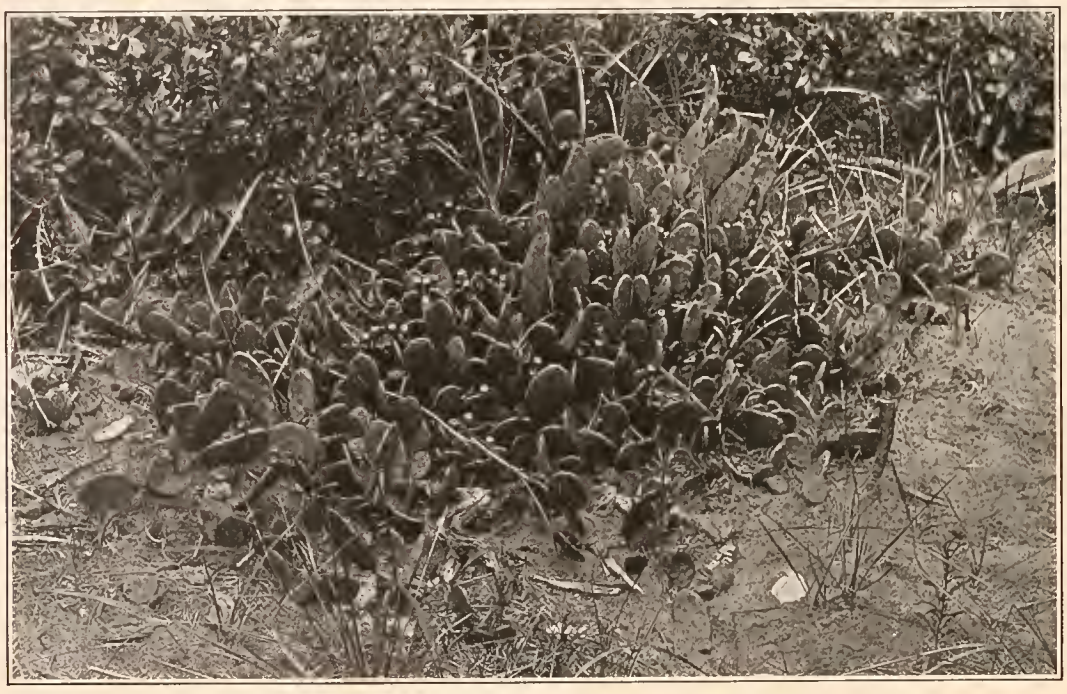


FIG. 160.—Opuntia opuntia in its natural surroundings on Staten Island, New York.

Illustrations: Illustr. Fl. 2: f. 2527; ed. 2. 2: f. 2986; Curtis's Bot. Mag. 50: pl. 2393; Loudon, Encycl. Pl. ed. 3. f. 6884, the last two as *Cactus opuntia;* De Candolle, Pl. Succ. Hist. 2: pl. 138 [A]; DeTussac, Fl. Antill. 2: pl. 30, the last two as *Cactus opuntia nana*. Dept. Agr. N. S. W. Misc. Publ. 253: pl. [1], f. 2; Engler and Prantl, Pflanzenfam. 3^{6a}: f. 57, G; Förster, Handb. Cact. ed. 2. f. 12; Pac. R. Rep. 4: pl. 10, f. 1, 2; 4: pl. 23, f. 13; Schumann, Gesamtb. Kakteen Nachtr. f. 1, all as *Opuntia vulgaris*. Standard Cycl. Hort. Bailey 4: f. 2602, in part as *Opuntia humifusa*. Amer. Entom. Bot. 2: f. 160; Amer. Garden 11: 462; Curtis's Bot. Mag. 115: pl. 7041; Dict. Gard. Nicholson 2: f. 756; Fl. Serr. 22: pl. 2328; Förster, Handb. Cact. ed. 2. f. 2; Gard. Mag. 4: 280; Gartenflora 24: 218; Lemaire, Cact. f. 9; Meehan's Monthly 2: pl. 6; 10: 121; Pac. R. Rep. 4: pl. 10, f. 4, 5; pl. 23, f. 7, 8; Rümpler, Sukkulenten f. 125; W. Watson, Cact. Cult. f. 84, all as *Opuntia rafinesquei;* Pac. R. Rep. 4: pl. 11, f. 1, as *Opuntia rafinesquei minor;* Förster, Handb.

M. E. Eaton del.

1. Joints of *Opuntia microdasys*.
2. Flowering joint of *Opuntia macrarthra*.
3. Fruit of *Opuntia macrarthra*.
4. Seed of same.
5. Flowering joint of *Opuntia opuntia*.

(All natural size except 4.)

Cact. ed. 2. f. 126, as *Opuntia rafinesquei arkansana;* Monatsschr. Kakteenk. 14: 124, as *Opuntia vulgaris nana;* Miller, Fig. Pl. Gard. Dict. 2: pl. 191, as *Opuntia folio minori*, etc., Dict. Hort. Bois f. 638; Rev. Hort. 40: f. 10, 11; 66: f. 59, all as *Opuntia rafinesquiana.* Wiener Illustr. Gartenz. 10: f. 112, as *Opuntia rafinesquiana arkansana.*

Plate XXII, figure 5, represents a flowering joint of the plant which grows naturally on schistose rocks in the New York Botanical Garden. Figure 160 is from a photograph of the plant growing on sand dunes at Crooke's Point, Staten Island, New York, taken by Howard H. Cleaves in 1914.

119. Opuntia macrarthra Gibbes, Proc. Elliott Soc. Nat. Hist. 1: 273. 1859.

Stems prostrate or ascending; joints narrowly oblong to obovate, 12 to 35 cm. long, thick, pale green, somewhat shining; leaves subulate, 10 mm. long, green, sometimes with purplish tips; areoles large, 2 to 3 cm. apart, filled with brown wool; spines wanting, or sometimes 1, up to 2.5 cm. long; glochids when present yellow; flowers not known; fruit narrowly obovoid, red, fleshy, 4 to 6 cm. long.

Type locality: Near Charleston, South Carolina.

Distribution: Coast of South Carolina.

This species, long overlooked, has recently been collected by Dr. J. K. Small in the vicinity of the type locality.

This is doubtless one of the species to which Elliott called attention and which he said he expected to publish, but never did.* The original description long remained unnoticed in the Proceedings of the Elliott Society of Natural History; it is as follows:

"The second, which we will call *Opuntia macrarthra*, falls under the same section with the preceding, and seems to be near *Opuntia angustata*, of Engelmann, from the west of the Rio Grande; a prostrate species, joints from ten to fifteen inches long and three inches wide, one-third of an inch thick; no spines, fruit two and a half inches long, slender, clavate."

Plate XV, figure 3, represents a fruiting joint collected by Dr. Small on James Island, South Carolina, in 1916; plate XXII, figure 2, represents a flowering joint of the plant collected by Dr. Small on the Isle of Palms, near Charleston, South Carolina, in 1916; figure 3 shows a fruit of the same plant and figure 4 a seed, enlarged.

FIGS. 161, 162.—Opuntia grandiflora.

120. Opuntia grandiflora Engelmann, Proc. Amer. Acad. 3: 295. 1856.

Opuntia rafinesquei grandiflora Engelmann, Pac. R. Rep. 4: 55. 1856.
Opuntia mesacantha grandiflora Coulter, Contr. U. S. Nat. Herb. 3: 429. 1896.

Low, with somewhat ascending branches; joints 12.5 to 15 cm. long; areoles 2.5 cm. apart; spines usually wanting; flowers very large, 11 to 12.5 cm. broad, yellow with a red center; petals broad; fruit elongated, 6 cm. long.

Type locality: On the Brazos, Texas.

Distribution: Eastern Texas.

Although Dr. Engelmann formally described this as a species, he introduced it as "probably only a southern variety of *O. rafinesquei*." A little later he actually used the name as a variety. The position of the plant is still uncertain; if specimens collected by Mr. Wm. R. Maxon at Victoria, Texas, and by Mr. C. V. Piper at Dallas, Texas, belong here, as they appear to, we believe it to be a distinct species.

Illustrations: Pac. R. Rep. 4: pl. 11, f. 2, 3, as *Opuntia rafinesquei grandiflora.*

Figures 161 and 162 are copied from the illustrations above cited.

*Cactus opuntia. "It is probable that there are now three distinct species on the sea coast of the Southern States covered under this name." Elliott, A Sketch of the Botany of South Carolina and Georgia, 1: 537.

121. Opuntia austrina Small, Fl. Southeast. U. S. 816. 1903.

Opuntia youngii C. Z. Nelson, Chicago Examiner. June 13, 1915.

Roots fusiform or tuberous, resembling sweet potatoes, often 4 to 6 cm. in diameter, 5 to 15 cm. long; stems erect or ascending; joints narrowly obovate to oblong-obovate, thick, tuberculate, repand, bright green, 5 to 12 cm. long; leaves soon deciduous, less than 10 mm. long; glochids yellowish; spines usually on the upper half and margin of the joint, often 2, sometimes 1 to 6, from an areole, whitish or pinkish, darker at base and apex, twisted, sometimes wanting; flowers bright yellow, 6 to 7 cm. broad; petals cuneate, truncate or retuse at apex, mucronate; fruit 2.5 to 3 cm. long.

FIG. 163.—Opuntia austrina. ×0.5.

Type locality: Miami, Florida.

Distribution: Southern Florida.

Opuntia youngii C. Z. Nelson, published in a Chicago newspaper, we have referred here, after studying a specimen sent by the author.

Opuntia spinalba Rafinesque (Atl. Journ. 1: 147. 1832) was described as from the keys of Florida, and answers in some respects to *O. austrina;* but it is very unlikely that any plants of the region inhabited by *austrina* were known to botanists as early as 1832.

Figure 163 represents a plant collected by Dr. Small at the type locality in 1901.

122. Opuntia macrorhiza Engelmann, Bost. Journ. Nat. Hist. 6: 206. 1850.

Opuntia fusiformis Engelmann and Bigelow, Proc. Amer. Acad. 3: 297. 1856.
Opuntia rafinesquei fusiformis Engelmann, Pac. R. Rep. 4: 43. 1856.
Opuntia mesacantha macrorhiza Coulter, Contr. U. S. Nat. Herb. 3: 430. 1896.
Opuntia xanthoglochia Griffiths, Rep. Mo. Bot. Gard. 21: 166. 1910.
Opuntia roseana Mackensen, Bull. Torr. Club 38: 142. 1911.

Plant low, usually nearly prostrate, forming a clump 1 meter in diameter, from a cluster of tuber-like roots, these sometimes 5 to 7.5 cm. in diameter; joints orbicular to obovate, dull green, 5 to 16 cm. long, about 1 cm. thick; leaves subulate, 4 to 10 mm. long; areoles rather large, the lower ones and sometimes all of them spineless; glochids numerous, yellow or brown; spines, when present, 1 to 4, unequal, yellow to brown, the longest 2.5 cm. long; flower yellow, with a reddish or purplish center, 7 to 8 cm. broad; fruit narrowly obovoid, 3.5 to 5 cm. long, purple or red, with a depressed umbilicus, not edible; seeds 5 mm. in diameter, with broad margins.

Type locality: Rocky places on the Upper Guadalupe, Texas.

Distribution: Missouri and Kansas to Texas.

Opuntia seguina C. Z. Nelson (Galesburg Register, July 20, 1915), published in a newspaper, and said to have come from San Antonio, Texas, seems to be one of the *Tortispinae,*

and is probably referable to *O. macrorhiza*. Through the kindness of Mr. Nelson, we have seen a joint of this species.

Opuntia bulbosa Engelmann (Proc. Amer. Acad. 3: 297. 1856) was used by Engelmann for *O. fusiformis*, but never described.

Opuntia macrorhiza, originally described by Dr. Engelmann as a species, was afterwards (Proc. Amer. Acad. 3: 296. 1856) proposed as a subspecies but not formally indicated, so that the reference *O. rafinesquei macrorhiza* Coulter (Contr. U. S. Nat. Herb. 3: 430. 1896) is the proper designation if it is used as a variety.

Illustrations: Cact. Mex. Bound. pl. 69; Förster, Handb. Cact. ed. 2. f. 11, 127; Pac. R. Rep. 4: pl. 12, f. 7, 8; pl. 23, f. 6; Suppl. Dict. Gard. Nicholson f. 606; W. Watson, Cact. Cult. f. 82, 83; Rep. Mo. Bot. Gard. 21: pl. 20, in part, this last as *Opuntia xanthoglochia;* Addisonia 1: pl. 19.

Plate XIV, figure 5, represents a flowering joint of the plant collected at Irving, Dallas County, Texas, by Albert Ruth in 1912.

123. Opuntia plumbea Rose, Smiths. Misc. Coll. 50: 524. 1908.

Plant low, creeping, 10 cm. high, 20 to 30 cm. broad, few jointed; joints small, nearly orbicular, 3 to 5 cm. in diameter, of a dull lead-color, the surface somewhat wrinkled in dead specimens; areoles rather large for the size of the joints; spines pale brownish, slender, usually porrect, often 3 cm. long, mostly 2 in number, rarely as many as 4, sometimes one or even wanting; flowers very small, red; ovary naked; fruit 1.5 to 2 cm. long with a few small areoles and these simply woolly; seeds small, rather turgid, smooth, and with a shallow obtuse margin.

FIG. 164.—Opuntia plumbea

Type locality: San Carlos Indian Reservation, Arizona.

Distribution: Arizona.

This is a peculiar little opuntia with very small joints and fruits. It is known only from the original collections made by Mr. F. V. Coville in 1904.

Figure 164 is from a photograph of the type specimen.

124. Opuntia tortispina Engelmann, Proc. Amer. Acad. 3: 293. 1856.

Opuntia tortisperma Engelmann, Pac. R. Rep. 4: pl. 23, f. 1 to 5. 1856.
Opuntia cymochila Engelmann, Proc. Amer. Acad. 3: 295. 1856.
Opuntia rafinesquei cymochila Engelmann, Proc. Amer. Acad. 3: 295. 1856.
Opuntia rafinesquei cycmochila montana Engelmann and Bigelow, Pac. R. Rep. 4: 42. 1856.
Opuntia mesacantha cymochila Coulter, Contr. U. S. Nat. Herb. 3: 430. 1896.
Opuntia mesacantha greenei Coulter, Contr. U. S. Nat. Herb. 3: 431. 1896.
Opuntia mesacantha oplocarpa Coulter, Contr. U. S. Nat. Herb. 3: 431. 1896.
Opuntia greenei Engelmann in Britton and Rose, Smiths. Misc. Coll. 50: 523. 1908.
(?) *Opuntia sanguinocula* Griffiths, Proc. Biol. Soc. Washington 27: 26. 1914.

Prostrate and creeping; joints ascending, orbicular to obovate, 15 to 20 cm. long; areoles 1.5 to 3 cm. apart; spines several, often 6 to 8, the upper and longer ones 3 to 6 cm. long, either white, yellowish, or brown; on the upper areoles one spine erect, the others spreading or with the lowermost ones deflexed; flowers sulphur-yellow, 6 to 7.5 cm. broad; fruit rather large, 4 to 5 cm. long, 2 to 3 cm. broad; seeds 4 to 6 mm. broad, thick, regular, with a slight indentation at the hilum.

Type locality: On the Camanchica Plains near the Canadian River.

Distribution: Wisconsin to South Dakota, Texas, Kansas, Colorado, and New Mexico.

This has long remained one of our least-understood species. We believe now that it has a wide range, and that it has been referred heretofore to several species. *Opuntia cymochila* does not seem to differ from it, and the two published varieties of *Opuntia mesacantha*, geographically out of harmony with that species, doubtless belong here.

Opuntia oplocarpa Engelmann (Coulter, Contr. U. S. Nat. Herb. 3: 431. 1896) was published only as a synonym. *Opuntia rafinesquei greenei* (Cat. Darrah Succ. Manchester 58. 1908) is a catalogue name.

The plant is hardy at New York, flowering profusely, and also at Buck Hill Falls, eastern Pennsylvania.

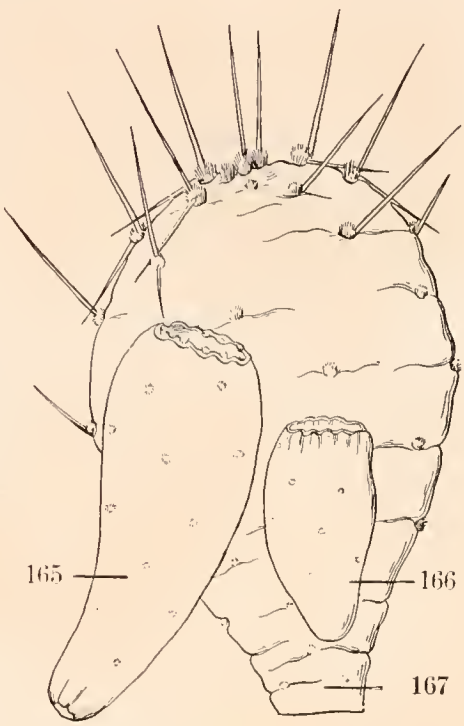
Illustrations: Pac. R. Rep. 4: pl. 12, f. 1 to 3; pl. 23, f. 10 to 12; Rev. Hort. Belg. 40: after 186, all as *Opuntia cymochila;* Illustr. Fl. 2: f. 2528; ed. 2. 2: f. 2987; Pac. R. Rep. 4: pl. 10, f. 3; Stand. Cycl. Hort. Bailey 4: f. 2602, in part, these as *Opuntia humifusa.* Pac. R. Rep. 4: pl. 8, f. 2, 3; pl. 23, f. 1 to 5, as *O. tortispcrma.* Illustr. Fl. 2: f. 2529; ed. 2. 2: f. 2988.

Plate xv, figure 4, represents a flowering and fruiting joint of a plant from Colorado, grown at the New York Botanical Garden.

125. Opuntia stenochila Engelmann, Proc. Amer. Acad. 3: 296. 1856.*

Opuntia mesacantha stenochila Coulter, Contr. U. S. Nat. Herb. 3: 430. 1896.

Prostrate; joints obovate, 10 cm. long by 7.5 cm. broad; leaves small, 4 to 6 mm. long; spines usually 2, sometimes 3, spreading, 1 long (2.5 to 3 cm. long), and 1 or 2 short and reflexed, usually light-colored, sometimes nearly white; glochids brown; flowers yellow, 6 cm. long; fruit very juicy, 4 to 5 cm. long or more, attenuate at base; seeds thick, quite regular, with very narrow obtuse edges.



Opuntia stenochila,
FIGS. 165, 166.—Fruits. FIG. 167.—Joint.

Type locality: Canyon of Zuni, New Mexico.

Distribution: Western New Mexico and Arizona.

This species has not been well understood. It has usually passed as a variety of the common species of the eastern Mississippi Valley States, but it grows in a very different region. It is the common low, spreading *Opuntia* of northwestern New Mexico and Arizona.

Illustrations: Pac. R. Rep. 4: pl. 12, f. 4 to 6; pl. 23, f. 9.

Figures 165, 166, and 167 are copied from the first illustration above cited.

126. Opuntia delicata Rose, Contr. U. S. Nat. Herb. 13: 310. 1911.

A small, procumbent plant with rather thin, ovate, bluish, slightly glaucous joints, often only 4 to 9 cm. in diameter; areoles prominent, bearing conspicuous brown glochids; lower areoles spineless, the upper ones bearing 1 or 2 very slender brownish spines, the longer one 3 to 4 cm. long; flowers yellow, 5 cm. long, 5 to 6 cm. broad; fruit oblong, spineless, 2 to 3 cm. long; seeds small, about 4 mm. in diameter, nearly smooth.

Type locality: Calabasas, Arizona.

Distribution: Southeastern Arizona.

Figure 168 is from a photograph of the type plant.

*Although formally published as a species, Engelmann states that it is a form or subspecies, and hence Coulter (Contr. U. S. Nat. Herb. 3: 430. 1896) uses the synonym *O. rafinesquei stenochila* Engelmann.

M. E. Eaton del.

1. Flowering joint of *Opuntia fuscoatra*. 2 Upper part of joint of *Opuntia sulphurea*.
3. Joint of *Opuntia tenuispina*. (All natural size.)

FIG. 168.—Opuntia delicata.

127. **Opuntia fuscoatra** Engelmann, Proc. Amer. Acad. 3: 297. 1856.

Diffuse prostrate plants; joints orbicular to obovate, somewhat tuberculate, 5 to 8 cm. long, areoles 12 to 20 mm. apart, very large for the group; spines single or in twos or threes, one rather stout, sometimes a little flattened, 2.5 to 3 cm. long, yellow to dark brown or even nearly black; usually from the lower areoles; glochids numerous, brown; flowers 7.5 cm. broad, yellow; petals very broad; stigma-lobes 5; ovary 2.5 cm. long, slender; fruit 4 to 5 cm. long, red; seeds 4 mm. broad.

Type locality: Sterile places of prairies west of Houston, Texas.
Distribution: Eastern Texas.
Illustrations: Pac. R. Rep. 4: pl. 11, f. 4.

Plate XXIII, figure 1, represents a flowering joint of the plant collected by W. L. McAtee at Rockport, Texas, in 1911.

127 *a*. **Opuntia macateei** sp. nov. (See Appendix, p. 221.)

OPUNTIA RUBIFLORA Griffiths, Bull. Torr. Club 43: 529. 1916.

Described as a spreading plant 3 to 4.5 dm. high and a meter broad, with obovate, green joints 12 to 18 cm. long, few white spines up to 5 cm. long with brown or straw-colored bases, and pink flowers. The species is based on cuttings received from European collections, and its origin is unknown.

We have received a similar if not identical plant from Haage and Schmidt of Erfurt, Germany, and we suspect it to be a hybrid, having one of the *Tortispinae* as one of its parents.

The specific name *rubiflora* was used by Davidson a few months earlier than by Griffiths for another plant.

Series 8. SULPHUREAE.

Low or prostrate species, with rather thick, flat, tuberculate joints; fruit small, nearly globular. Three species, natives of central and southern South America.

KEY TO SPECIES.

Flowers yellow.
- Spines stout, subulate ..... 128. *O. sulphurea*
- Spines slender, acicular ..... 129. *O. soehrensii*

Flowers red ..... 130. *O. microdisca*

128. Opuntia sulphurea G. Don in Loudon, Hort. Brit. 196. 1830.

Opuntia maculacantha Förster, Handb. Gartenz. 17: 166. 1861.
Opuntia pampeana Spegazzini, Contr. Fl. Ventana 30. 1896.
Opuntia vulpina Weber, Dict. Hort. Bois 895. 1898.

Plants low and spreading, forming broad clumps 1 to 2 meters in diameter, 3 dm. high or less; joints flattened, oblong to obovate, 12 to 25 cm. long, thick, strongly tuberculate, usually green but sometimes purplish; terminal joints easily detached; leaves conic, about 2 mm. long; spines 2 to 8, generally straight but sometimes curved and twisted, spreading, 3 to 10 cm. long, brownish to red, but sometimes quite pale at first; flowers about 4 cm. long, yellow; fruit with a deep umbilicus, short, about 1 cm. long.

Type locality: Cited as Chile, but doubtless wrong.

Distribution: Dry parts of western Argentina; recorded also from Chile, and perhaps occurring in Bolivia.

This species was not seen in Chile by Dr. Rose, and we are doubtful in considering the Bolivian material to be *O. sulphurea;* the joints, as shown by Dr. Rose's specimens, collected at La Paz (No. 18860), while thick, are not conspicuously tuberculate; the spines are rather short and stiff, white at first, but somewhat yellowish or horn-colored in age.

The name *Cactus sulphureus* Gillies was published by G. Don at the place cited above as a synonym of this species.

Opuntia maculacantha was first described from specimens from Buenos Aires, which had doubtless been sent down from the desert regions to the west or northwest. Schumann in his Monograph referred this species to Mexico, but in his Nachtrag corrects this statement. Dr. Weber, with whom we are in agreement, refers the species to *O. sulphurea.* It is the only species we know with such large tubercles on the joints.

Several varieties of this species, some of which have been described, are given, such as *laevior, major, minor,* and *pallidior.*

Here probably belongs *Opuntia sericea* G. Don (Salm-Dyck, Hort. Dyck. 363. 1834), also reported from Chile, but doubtless from Argentina. *Cactus sericeus* Gillies (Loudon, Hort. Brit. 196. 1830) is the same. There are several varieties of *O. sericea* which we would put with it: *longispina* Salm-Dyck (Hort. Dyck. 363. 1834); *coerulea* Forbes (Hort. Tour Germ. 159. 1837) which is probably *O. coerulea* Gillies (Pfeiffer, Enum. Cact. 155. 1837); *maclenii* Salm-Dyck (Cact. Hort. Dyck. 1844. 46. 1845) which is *O. maclenii* (Salm-Dyck, Cact. Hort. Dyck. 1844. 46. 1845). *Opuntia tweedici* (Schumann, Gesamtb. Kakteen 745. 1898) is given as a synonym of this species by Schumann. *Opuntia albisetosa* Hildmann, a name only, belongs here according to Hirscht (Monatsschr. Kakteenk. 10: 48. 1900).

Illustrations: Blühende Kakteen 3: pl. 136; Monatsschr. Kakteenk. 8: 121; Schumann, Gesamtb. Kakteen f. 106, all as *Opuntia maculacantha.*

Plate XXIII, figure 2, represents a flowering joint of the plant collected by Dr. Rose near Córdoba, Argentina, in 1915.

129. Opuntia soehrensii sp. nov.

Prostrate, in masses usually 1 meter in diameter or less; joints at first erect or ascending, finally prostrate and rooting and forming new colonies, flattened, rather thin, somewhat tuberculate, very spiny, orbicular, 4 to 6 cm. in diameter, often purplish; spines slender, rather variable in color, usually yellow or brown, several from each areole, sometimes as many as eight, the longest ones 5 cm. long, erect; flowers light yellow, 3 cm. long; sepals brown; filaments yellow; style white; stigma-lobes green; fruit naked, 3 cm. long; seeds 3 to 3.5 mm. broad, ovate, thickish, with narrow margin and roughened sides.

Highlands of southern Peru, Bolivia, and northern Argentina. Type collected by Dr. and Mrs. J. N. Rose below Pampa de Arrieros, Peru, August 23, 1914 (No. 18967).

This species is very common in its region, but as it is cultivated somewhat for its seeds as well as used as a protection for gardens and yards, its natural distribution is difficult to determine. On the barren hills below La Paz, Bolivia, the species is well established and

grows as if native; on some of these hills it is the dominant and sometimes exclusive plant. In the same general region, however, one finds the plant about the houses, especially on walls, where it has undoubtedly been planted. At Oruro, Bolivia, it was seen only in the wild state, while at several stations along the railroad between Juliaca and Cuzco, Peru, especially at Combatata and Tinta, Peru, it has been planted on top of many of the mud walls about the yards. On the hills below Pampa de Arrieros, Peru, the species is extremely common and undoubtedly native.

The plant is known everywhere by the natives as ayrampo. The seeds are collected in great quantity and dried, and may be bought in the market places, especially in Arequipa. Indeed, there must have been a time when they were shipped by freight, for the name Ayrampo has always appeared on the printed freight classification of the Southern Railroad of Peru. The assistant superintendent of the road, Mr. Brown, states that, so far as he knows, there are few or no shipments made now. One of the places in Peru where Dr. Rose found the plant very abundant is named Ayrampal.

The dry seeds, when placed in water, yield a red substance which is used for coloring jellies and gelatine and, according to some, for coloring wines. In former days the Indians also used this substance in some of their carnival ceremonies. The coloring matter does not come from the seeds themselves, but from the red juice of the fruit which has dried on the surfaces.

Figure 169 represents a joint of this species collected by Dr. Rose at Oruro, Bolivia, in 1914.

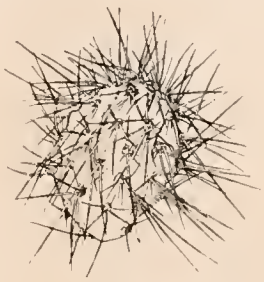


FIG. 169.—Opuntia soehrensii. ×0.4.

130. Opuntia microdisca Weber, Diet. Hort. Bois 896. 1898.

Forming small clumps, very much branched, prostrate; joints mostly obovate to oblong, 4 to 8 cm. long, usually much flattened, but sometimes nearly cylindric, grayish green; leaves minute, purple, soon dropping off; areoles numerous, 5 to 6 mm. apart, rather large, when young densely white-felted; spines 10 to 15, white to reddish, unequal, some of the centrals 1.5 to 2.5 cm. long; glochids numerous, yellow; flower-buds red; flowers 2.5 cm. long, bright red; filaments purple; style white; stigma-lobes 6 to 8, short; ovary turbinate, 16 mm. long, bearing numerous areoles subtended by narrow red leaves; areoles on ovary densely felted and bristly; fruit red.

Type locality: In Catamarca, Argentina.

Distribution: Northern Argentina.

Schumann refers this species to *Platyopuntia*, while Weber referred it to *Tephrocactus*. It evidently belongs to our *Sulphureae*, being nearest our *O. soehrensii*.

Our description is drawn chiefly from specimens obtained by J. A. Shafer between Andalgala and Concepción, Argentina, in 1916, supplemented by a living specimen obtained by Dr. Spegazzini in 1915. In Argentina this species also is known as ayrampo.

Figure 170 represents a joint of the plant collected by J. A. Shafer between Andalgala and Concepción, Argentina, December 28, 1916 (No. 24).

To this relationship may belong the following species:

FIG. 170.—Joint of Opuntia microdisca. ×0.7.

OPUNTIA PENICILLIGERA Spegazzini, Anal. Mus. Nac. Buenos Aires II. 4: 291. 1902.

Low, nearly prostrate; joints flattened, orbicular to broadly obovate, 10 to 12 cm. long, 7 to 10 cm. broad, dull green; spines slender, twisted, one elongated and 1 to 5 cm. long, the others much shorter, all white; glochids brownish; flowers from the lateral and marginal areoles, citron-yellow;

ovary 3 to 3.5 cm. long, with very many areoles bearing numerous glochids; style thick; stigma-lobes 8 to 10, greenish white; fruit reddish, clavate, 4.5 cm. long, with a depressed umbilicus; seeds small, 3 to 3.5 mm. broad.

Type locality: Argentina, between Río Negro and Río Colorado.

Distribution: Southern Argentina.

According to Dr. Spegazzini, this species is not near to any of the known South American species, but resembles somewhat the North American species *O. microdasys* and *O. basilaris*. We know it only from the description.

OPUNTIA CALANTHA Griffiths, Bull. Torr. Club 43: 524. 1916.

A low, creeping, prostrate plant 15 cm. high, one meter in diameter; joints obovate, narrowed above and below, inequilateral, 11 cm. long, 4 cm. broad, tuberculate-wrinkled, mostly deep green; areoles 1 to 1.5 mm. long, obovate, at first tawny, turning gray; leaves small, subulate, cuspidate, red. 1 mm. long; glochids yellow; spines 5 to 10, up to 5 mm. long; flowers carmine; fruit globular, 1.5 cm. in diameter.

Recorded as probably of South American origin and usually distributed as *Opuntia microdisca*, but from which it is said to differ very much. The plant is known to us only from the description of cultivated specimens.

Series 9. STRIGILES.

The series consists of a single species, native of Texas. It is a low, bushy plant with large joints bearing many areoles, these close together, each with several acicular, reddish brown spines; the fruit is small.

131. Opuntia strigil Engelmann, Proc. Amer. Acad. 3: 290. 1856.

Suberect, 6 dm. high; joints orbicular to obovate, 10 to 12.5 cm. long; areoles close together, prominent; spines 5 to 8, spreading, many of them appressed to the joint and deflexed, red to reddish brown with lighter tips, the longer ones 2.5 cm. long; glochids numerous; flowers unknown; fruits small, nearly globular, 12 mm. in diameter, truncate, red; areoles on fruit very small; seeds 3 mm. broad.

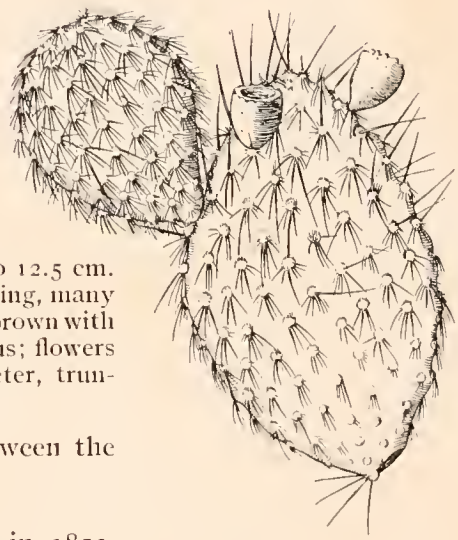


FIG. 171.—Opuntia strigil. ×0.4.

Type locality: In crevices of limestone rock, between the Pecos River and El Paso, Texas.

Distribution: Texas.

A rare plant, first collected by Charles Wright in 1851. Engelmann says in the Mexican Boundary Report that it was also collected by Wright and Bigelow, but there is no mention of it in his report on Bigelow's plants, nor do we find specimens in the Engelmann herbarium, so that it would appear that this reference to Bigelow was a mistake. Bigelow, it is true, crossed the River Pecos, on which the type was found, but it was well up in New Mexico and not in Texas, where it was crossed by Charles Wright. It was more recently collected by Nealley somewhere in Texas. The place of collection by Wright and the later one by Nealley are very indefinitely indicated on the labels accompanying the specimens.

Illustration: Cact. Mex. Bound. pl. 67.

Figure 171 is copied from the illustration above cited.

Series 10. SETISPINAE.

Bushy or depressed species, with tuberous or thickened roots, broad, flat, thin joints, and elongated, acicular, brown spines which fade whitish; their fruits are large and juicy. We recognize six species, natives of the south central and southwestern United States and northern Mexico. They approach the *Tortispinae* on the one hand and the *Phaeacanthae* on the other.

Key to Species.

Joints elongated ..... 132. *O. megarhiza*
Joints obovate to orbicular.
  Fruit small, 2 cm. long or less ..... 133. *O. ballii*
  Fruit large 2.5 to 6 cm. long.
    Flowers red to purple ..... 134. *O. pottsii*
    Flowers yellow.
      Areoles large, more or less elevated on old joints; joints glaucous, purplish about the areoles ..... 135. *O. setispina*
      Areoles small; mature joints green throughout.
        Joints usually orbicular; seeds 5 to 6 mm. broad ..... 136. *O. mackensenii*
        Joints obovate; seeds 4 mm. broad or less ..... 137. *O. tenuispina*

132. Opuntia megarhiza Rose, Contr. U. S. Nat. Herb. **10**: 126. 1906.

Roots long and thickened, sometimes 3 to 6 dm. long, 5 to 6 cm. in diameter; stems low, 2 to 3 dm. high, much branched; lower joints elongated, 2 to 3 dm. long, cuneate below, thin, 3 cm. broad; lateral joints appearing along the margins of the older joints and often, if not always, in the same plane; spines 2 to 4, acicular, 1 to 2.5 cm. long, brown; leaves minute; flowers lemon-yellow, often tinged with rose, 5 cm. broad; petals about 13, obovate, mucronately tipped; stigma-lobes 7, greenish; ovary clavate, 3 cm. long; fruit and seeds unknown.

Type locality: Alvarez, Mexico.

Distribution: San Luis Potosí, Mexico.

This species is not very closely related to the other species of this series, but it is referred here on account of its very slender spines.

133. Opuntia ballii Rose, Contr. U. S. Nat. Herb. **13**: 309. 1911.

Plants low, spreading; joints obovate, 6 to 10 cm. long, thickish, pale green, glaucous; spines 2 to 4, brownish, a little flattened, usually ascending or erect, the larger ones 4 to 7 cm. long; glochids conspicuous; fruit small, about 2 cm. long, clavate, glaucous, spineless; seeds thick, 3.5 mm. broad.

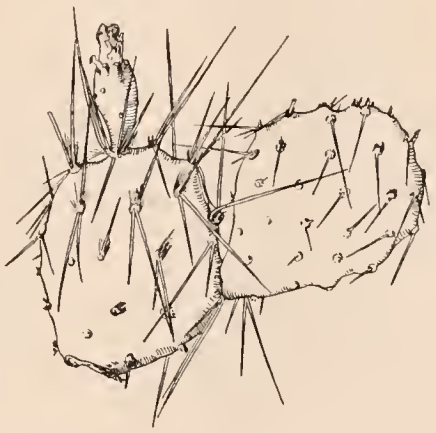


Fig. 172.—O. ballii. Part of type. ×0.5.

Type locality: Pecos, Reeves County, Texas.

Distribution: Western Texas.

Wooton and Standley in their Flora of New Mexico refer this species to *Opuntia filipendula*, but *O. ballii* grows in a different habitat, has smaller fruit, stouter and erect spines, and different areoles; it grows on the dry mesa beyond Pecos, Texas.

Illustrations: Contr. U. S. Nat. Herb. **13**: pl. 64.

Figure 172 is copied from the illustration above cited.

134. Opuntia pottsii Salm-Dyck, Cact. Hort. Dyck. 1849. 236. 1850.

Opuntia filipendula Engelmann, Proc. Amer. Acad. **3**: 294. 1856.

Low, spreading plant, 3 dm. high or less, from thickened tuberous roots 2 to 3 cm. in diameter, these sometimes moniliform; joints broadly obovate, 3.5 to 12 cm. long, pale green to bluish; areoles few, either small or large; spines confined to the upper and marginal areoles, 1 or 2, slender, 2 to 4 cm. long, usually white but sometimes purplish; glochids yellow, usually few but sometimes abundant; flowers large, 6 to 7 cm. broad, deep purple; ovary slender, 3 to 3.5 cm. long, with only a few scattered areoles; fruit spineless.

Type locality: Near Chihuahua City, Mexico.

Distribution: Central Chihuahua, Mexico, to Texas and New Mexico.

This species was described by Prince Salm-Dyck in 1850 from material collected by John Potts, who was manager of the mint at Chihuahua and who sent many cacti to F. Scheer at Kew between 1842 and 1850. No types of his species seem to have been retained.

In 1885 C. G. Pringle again collected this species near Chihuahua City and it was distributed as *O. filipendula*, and there Coulter leaves Pringle's specimen (Cont. Nat. Herb. 3: 428). Dr. E. Palmer collected an abundance of material in 1908 which enabled us to reestablish *O. pottsii*, which Coulter omits and Schumann lists under unknown species.

If these Chihuahua specimens are the same as the Texas plants, as Coulter believed and as we regard them, then *Opuntia filipendula* must give place to the older name of Salm-Dyck.

Illustrations: Cact. Mex. Bound. pl. 68; Förster, Handb. Cact. ed. 2. f. 10, 131; Suppl. Dict. Gard. Nicholson 2: f. 605; W. Watson, Cact. Cult. f. 81, all as *Opuntia filipendula*.

Figure 173 shows a joint of a plant collected by Dr. Rose in the valley of the Rio Grande below El Paso, Texas, in 1913.

135. Opuntia setispina Engelmann in Salm-Dyck, Cact. Hort. Dyck. 1849. 239. 1850.

Stem branching and spreading, sometimes 9 to 12 dm. broad, with some of the branches composed of 3 or 4 joints, erect and 6 dm. high; joints deep bluish green, somewhat glaucous, often purplish at the areoles, sometimes more or less tinged with purple throughout, obovate to orbicular, 5 to 15 cm. in diameter; leaves minute, subulate; spines 1 to 6 from an areole, white, 2 to 3 cm. long; glochids yellow, very conspicuous on old joints; flowers yellow; fruit purplish, about 4 cm. long.

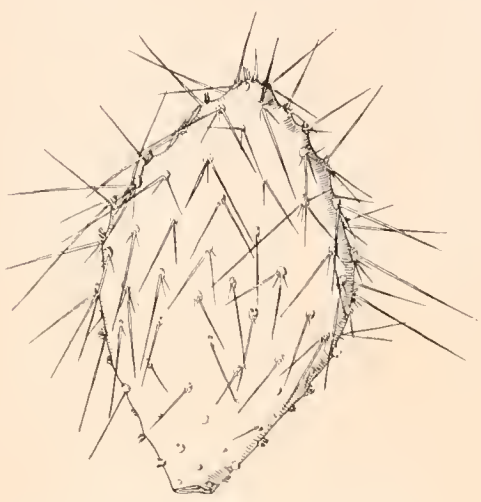


Fig. 173.—Opuntia pottsii. ×0.4.

Fig. 174.—Opuntia setispina. ×0.4.

Type locality: Pine woods in the mountains west of Chihuahua, Mexico (*fide* Engelmann, Proc. Amer. Acad. 3: 294. 1856).

Distribution: Western Chihuahua, Mexico.

This species has long been known only from the type specimens; but in 1908 Dr. Rose visited western Chihuahua, where this species is quite common; our description is based largely upon the specimens he then collected.

Figure 174 represents a joint of the plant collected by Dr. Rose near Miñaca, Chihuahua, in 1908.

136. Opuntia mackensenii Rose, Contr. U. S. Nat. Herb. 13: 310. 1911.

Plants low, with thick, tuberous roots, spreading, usually resting on the edges of the joints, but some of the branches often erect; joints orbicular to obovate, 10 to 20 cm. long, rarely broader than long, pale and glaucous when young, deep green when older; areoles small, the lower ones without spines, the upper ones with 1 to 4 spines; spines white or brown, or brown at base and white above, somewhat flattened and twisted, slender, 5 cm. long or less; glochids brown; flowers of medium size, 7 to 8 cm. broad, yellow with a reddish brown center; stigma-lobes 7 to 9, white; fruit spineless, 4 to 6 cm. long, truncate or nearly so at apex, rose-purple; seeds suborbicular, 5 to 6 mm. broad, acute on the margin.

Type locality: Near Kerrville, Texas.

Distribution: Kerr County, Texas.

Illustrations: Contr. U. S. Nat. Herb. 13: pl. 67; Plant World 19: 142. f. 1; 143. f. 2, the last as *O. macrorhiza*.

Figure 175 is from a photograph of the type plant from near Kerrville, Texas.

FIG. 175.—Opuntia mackensensii.

137. Opuntia tenuispina Engelmann, Proc. Amer. Acad. 3: 294. 1856.

Opuntia minor C. Mueller in Walpers, Ann. Bot. 5: 50. 1858.

Low and spreading, but becoming 3 dm. high; joints obovate, attenuate at base, 7 to 15 cm. long, light green; leaves very slender, 4 mm. long or less; spines 1 to 3 from an areole, slender, usually white but sometimes brownish, 3 to 5 cm. long, the upper spines erect or spreading; glochids brown; flowers yellow, 6 to 7.5 cm. broad; ovary with numerous areoles filled with brown wool and brown glochids; fruit oblong, 2.5 to 4 cm. long, with a deep umbilicus; seeds 4 mm. broad or less, very irregular.

Type locality: Sand hills near El Paso, Texas.

Distribution: Southwestern Texas and adjacent parts of Mexico and New Mexico, apparently extending to Arizona.

Engelmann says that this plant grows with *O. phaeacantha*, but is readily distinguished from the latter by its spines and fruit. Cultivated plants and herbarium specimens closely resemble *O. phaeacantha*.

Illustrations: Cact. Mex. Bound. pl. 75, f. 14; N. Mex. Agr. Exp. Sta. Bull. 78: pl. [15].

Plate XXIII, figure 3, represents a joint of the plant collected by Dr. Rose near El Paso, Texas, in 1913.

Series 11. PHAEACANTHAE.

Bushy or depressed species, with relatively large, flat, persistent joints, the subulate, usually stout spines brown at least at the base, or in some species nearly white. The series is composed of about fifteen species, natives of the south central and southwestern United States, northern and central Mexico.

Key to Species.

More or less bushy plants.
- Joints thin; spines, when present, very long and confined to the upper and middle areoles.
  - Spines dark brown, stout, rigid.
    - Plant pale green to purplish; spines up to 12 cm. long ..... 138. *O. macrocentra*
    - Plant dull dark green; spines 6 cm. long or less ..... 139. *O. tardospina*
  - Spines pale brown, flexible or subulate.
    - Usually abundantly spiny ..... 140. *O. gosseliniana*
    - Usually spineless or some areoles with 1 setaceous deflexed spine ..... 141. *O. santa-rita*
- Joints thick; spines not confined to the upper and middle areoles.
  - Joints relatively small, seldom over 15 cm. broad; plants relatively low.
    - Joints narrowly obovate, about twice as long as wide ..... 142. *O. angustata*
    - Joints broadly obovate to orbicular.
      - Flowers yellow.
        - Spines subulate, brown at least in part.
          - Plant light green ..... 143. *O. atrispina*
          - Plant bluish green or grayish green.
            - Plant erect, 2 meters high or less ..... 144. *O. azurea*
            - Plant bushy, rarely over 1 meter high ..... 145. *O. phaeacantha*
            - Plant prostrate ..... 146. *O. mojavensis*
        - Spines acicular, nearly white ..... 147. *O. covillei*
      - Flowers magenta ..... 148. *O. vaseyi*
  - Joints relatively large, mostly over 15 cm. broad; plants relatively tall.
    - Spines clear brown nearly throughout ..... 149. *O. occidentalis*
    - Spines nearly white above or throughout.
      - Spines with dark brown bases ..... 150. *O. engelmannii*
      - Spines whitish throughout ..... 151. *O. discata*

Small creeping plants ..... 152. *O. rastrera*

138. Opuntia macrocentra Engelmann, Proc. Amer. Acad. 3: 292. 1856.

Somewhat bushy, with ascending branches, 6 to 9 dm. high; joints orbicular to oblong, or sometimes broader than long, 10 to 20 cm. long, often bluish or purplish, sometimes spineless but usually bearing spines at the uppermost areoles; spines 1 or 2, rarely 3 together, usually brownish or black but sometimes white above, slender, erect or porrect, 4 to 7 cm. long; flowers yellow, often drying red, 7.5 cm. broad; sepals ovate, acuminate; ovary with few areoles, these bearing brown glochids; filaments very short; fruit 3 to 6 cm. long, purple; seeds 4 to 4.5 mm. broad.

Type locality: Sand hills on the Rio Grande near El Paso, Texas.

Distribution: Western Texas to Eastern Arizona and Chihuahua, Mexico.

This species, especially the forms that have bluish and purplish joints, are very showy. Seedlings sometimes produce long, silky hairs from the areoles, in this respect resembling the *Criniferae*.

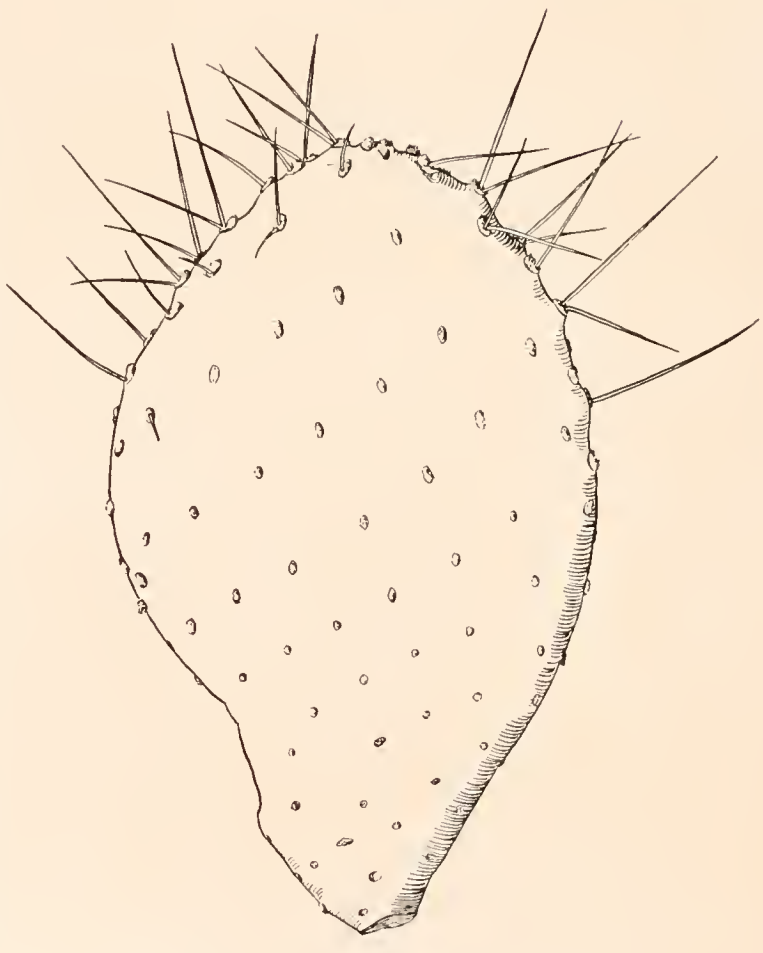


Fig. 176.—Opuntia macrocentra. ×0.5.

Illustrations: Cact. Mex. Bound. pl. 75, f. 8; N. Mex. Agr. Exp. Sta. Bull. 78: pl. [8].

Figure 176 represents a joint of the plant collected by Dr. Rose near the Rio Grande in New Mexico, northwest of El Paso, Texas, in 1913.

139. Opuntia tardospina Griffiths, Rep. Mo. Bot. Gard. 22: 34. 1912.

Roots fibrous; low, spreading plant, the joints usually resting on the ground; joints orbicular to obovate, 16 to 24 cm. long; areoles large, usually distant, often 4 cm. apart; spines usually wanting except from the upper areoles and along the upper margin, usually single, sometimes 2 from an areole, 4 to 5 cm. long, brown, but lighter towards the apex; glochids numerous, brown, persistent; fruit red, 6 cm. long; seeds 5 mm. broad, acute on the margin.

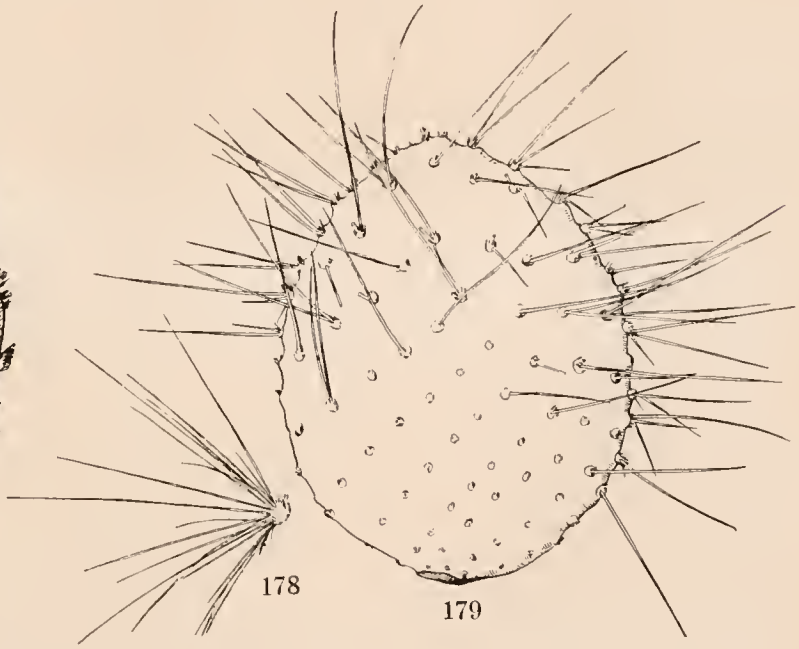
Type locality: Near Lampasas, Texas.

Distribution: Eastern Texas.

Illustrations: Rep. Mo. Bot. Gard. 22: pl. 11, in part; pl. 15.

Figure 177 represents a joint of the plant collected by Albert Ruth in 1912, north of Dallas, Texas.

FIG. 177.—O. tardospina. ×0.5.



FIGS. 178, 179.—Cluster of spines and joint of O. gosseliniana. ×0.4.

140. Opuntia gosseliniana Weber, Bull. Soc. Acclim. France 49: 83. 1902.

One meter or more high, branching from the base, the old trunk often bearing numerous, long, acicular spines; joints usually red or purplish, usually very thin, as broad as or broader than long, sometimes 2 dm. broad; lower and sometimes all the areoles without spines; spines porrect or nearly so, generally 1, sometimes 2, rarely 3 from an areole, 4 to 5 or even 10 cm. long, brown, usually weak; glochids brown, numerous, forming on old joints very large clusters; fruit 4 cm. long, without spines but bearing numerous brown glochids at the areoles, with a depressed umbilicus.

Type locality: Coast of Sonora on the Gulf of California.

Distribution: Sonora and Lower California, Mexico.

This species was placed tentatively in the *Pubescentes* by Schumann, although always glabrous; but it belongs better in the *Phaeacanthae*. In some of its phases it resembles *O. macrocentra*. It is a very showy species and worthy of a place in any collection.

Illustrations: Monatsschr. Kakteenk. 17: 69.

Figure 179 represents a joint of the plant collected at Hermosillo in Sonora, by Rose, Standley, and Russell in 1910; figure 178 shows a cluster of spines from a trunk areole.

141. **Opuntia santa-rita** (Griffiths and Hare) Rose, Smiths. Misc. Coll. **52**: 195. 1908.

Opuntia chlorotica santa-rita Griffiths and Hare, N. Mex. Agr. Exp. Sta. Bull. **60**: 64. 1906.
Opuntia shreveana C. Z. Nelson, Galesburg Register, July 20, 1915.

Compact plant, 6 to 14 dm. high, with a very short trunk; joints orbicular or a little broader than long, bluish green but deep purple about the areoles and margins; areoles 1.5 cm. apart, bearing numerous chestnut-brown glochids and occasionally a brown spine; flowers very handsome, deep yellow, 6 to 7 cm. broad; ovary purple, oblong.

Type locality: Selero Mountains, Arizona.

Distribution: Southeastern Arizona.

This species is one of the most ornamental of the opuntias, and although it does not grow well in greenhouse cultivation, it would doubtless flourish in the Southwest, where it could be given conditions similar to its wild surroundings.

Illustrations: Smiths. Misc. Coll. **52**: pl. 15; Plant World **11**[10]: f. 6, this last as *Opuntia chlorotica;* Journ. Inter. Gard. Club **3**: facing page 5, as *O. chlorotica santa-rita.*

Plate XXIV, figure 1, is from a photograph taken by Dr. MacDougal of a plant near Surritas, Arizona, in 1906.

142. **Opuntia angustata** Engelmann, Proc. Amer. Acad. **3**: 292. 1856.

Ascending to erect; joints narrow, 15 to 25 cm. long, rounded above, gradually narrowing downward; areoles distant, often 2.5 cm. apart, large, oblong; spines sharply angled, straw-colored or whitish but with brown bases, 2.5 to 3.5 cm. long; glochids brown; fruit obovoid, 2.5 to 3 cm. long.

Type locality: Bottoms, Bill Williams Fork, Arizona.

Distribution: Recorded as extending from New Mexico to California, but known definitely to us only from central Arizona, perhaps extending north to Utah.

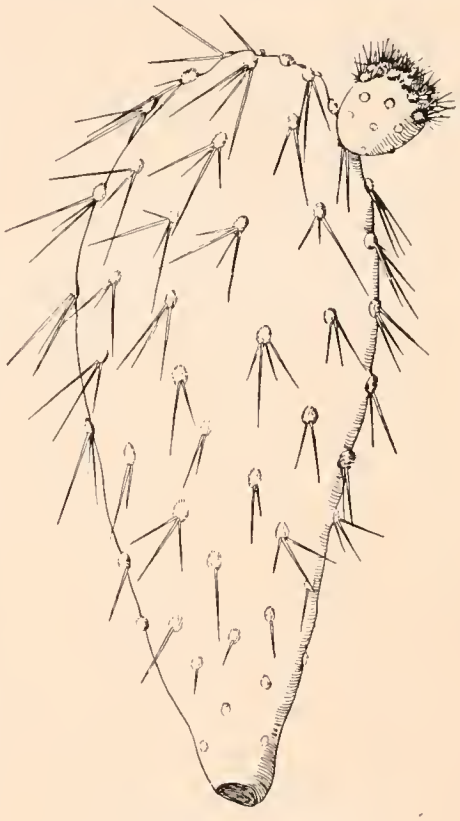


FIG. 180.—Opuntia angustata.

Engelmann's *Opuntia angustata* was based on three specimens, one from New Mexico, one from Arizona, and one from California. He stated that the first and last were prostrate, while the second was erect. A study of his specimens and descriptions indicates that he had three species before him. The first is from Zuni, New Mexico, and is probably *Opuntia phaeacantha.* The California specimen is the *Opuntia magenta* Griffiths, which is probably the same as *O. vaseyi,* while the suberect plant from the bottoms of the Bill Williams River we have allowed to stand for *O. angustata.* Wooton and Standley (Contr. U. S. Nat. Herb. **19**: 447. 1915) suggest that the two fruits illustrated by Engelmann in connection with this species may belong to two species of *Cylindropuntia.*

This plant was first collected by J. M. Bigelow, February 4, 1854.

Illustrations: Pac. R. Rep. **4**: pl. 7, f. 3, 4.

Figure 180 is copied from figure 3 of the illustrations above cited.

143. **Opuntia atrispina** Griffiths, Rep. Mo. Bot. Gard. **21**: 172. 1910.

Usually low and spreading, sometimes 2 meters in diameter, but sometimes the central branches nearly erect and 6 dm. high; joints rather small, nearly orbicular, 10 to 15 cm. in diameter, light green, sometimes a little glaucous; lower areoles spineless; spines from the upper areoles 2 to 4, the principal ones spreading, flattened, dark brown, almost black at base, much lighter above; glochids at first yellow or yellowish, but soon changing to brown; flowers described as yellow, changing to orange; fruit reddish purple.

1

2

1. Plant of *Opuntia santa-rita*.

2. Plant of *Opuntia discata*.

Type locality: Near Devil's River, Texas.

Distribution: Type locality and vicinity.

This plant is abundant between Del Rio, Texas, and Devil's River, being one of the two commonest species in that region.

Illustrations: Rep. Mo. Bot. Gard. 21: pl. 26, in part.

Plate XXV, figure 1, represents a flowering joint of the plant collected near Devil's River, Texas, by Dr. Rose in 1913.

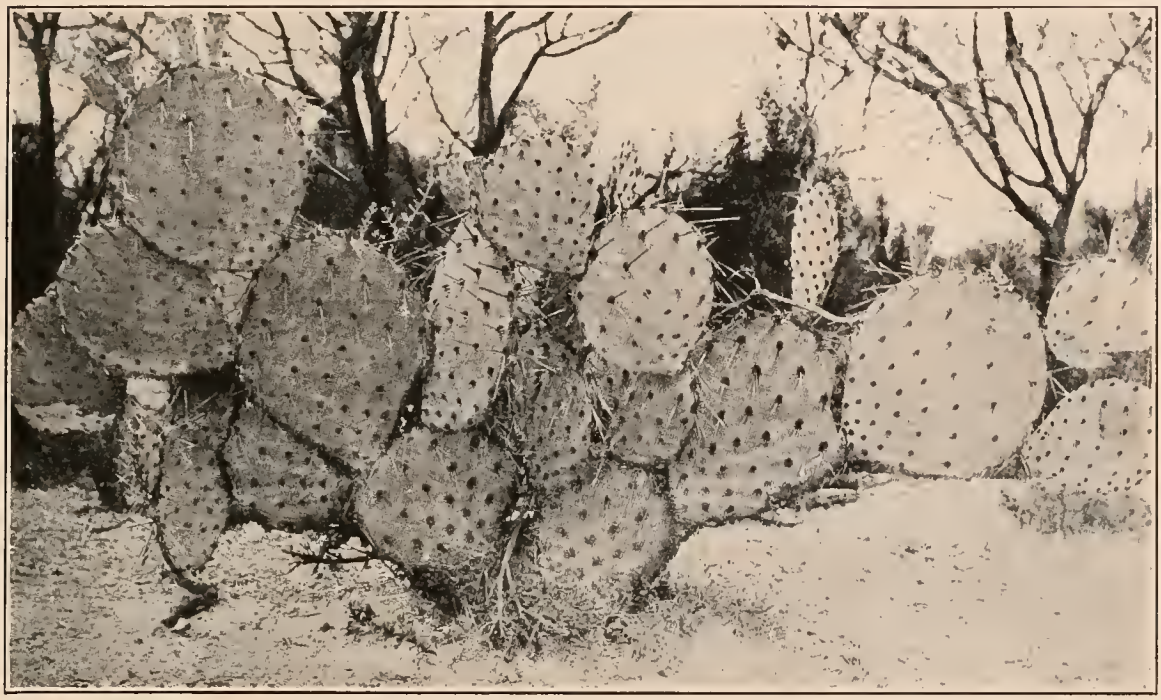


FIG. 181.—Opuntia azurea, Zacatecas, Mexico.

144. **Opuntia azurea** Rose, Contr. U. S. Nat. Herb. 12: 291. 1909.

Compact, upright, with a single trunk, or branching from the base and more or less spreading; joints orbicular to obovate, 10 to 15 cm. in diameter, pale bluish green, glaucous; areoles about 2 cm. apart, the lower ones spineless, the upper ones with 1 to 3 rather stout spines; spines, at least when old, almost black, unequal, the longer ones 2 to 3 cm. long, more or less reflexed; glochids numerous, brown; petals 3 cm. long, deep yellow, with crimson claw, but in age pink throughout; filaments greenish or almost white; stigma-lobes pale green; fruit dull crimson, subglobose to ovoid, spineless, truncate, juicy, edible.

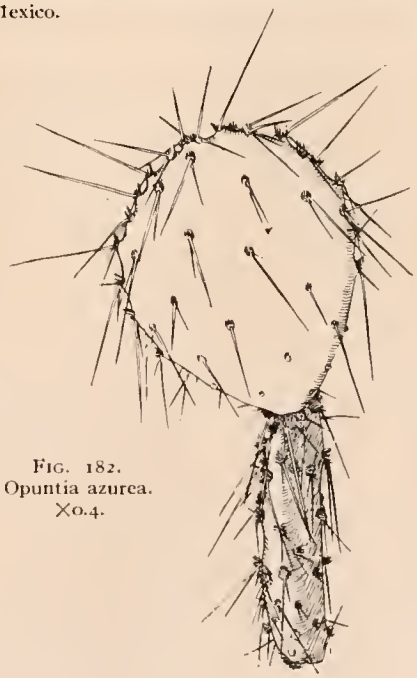


FIG. 182.
Opuntia azurea.
X0.4.

Type locality: Northeastern Zacatecas, Mexico.

Distribution: Zacatecas and probably Durango.

Illustrations: Contr. U. S. Nat. Herb. 12: pl. 24; also f. 33.

Figure 181 is from a photograph by F. E. Lloyd of the type plant; figure 182 represents joints of the plant collected by Albert de Lautreppe near Zacatecas, Mexico, in 1904.

145. **Opuntia phaeacantha** Engelmann in Gray, Mem. Amer. Acad. 4: 52. 1849.

Opuntia phaeacantha brunnea Engelmann, Proc. Amer. Acad. 3: 293. 1856.
Opuntia phaeacantha major Engelmann, Proc. Amer. Acad. 3: 293. 1856.
Opuntia phaeacantha nigricans Engelmann, Proc. Amer. Acad. 3: 293. 1856.
Opuntia camanchica Engelmann and Bigelow, Proc. Amer. Acad. 3: 293. 1856.
Opuntia chihuahuensis Rose, Contr. U. S. Nat. Herb. 12: 291. 1909.
Opuntia toumeyi Rose, Contr. U. S. Nat. Herb. 12: 402. 1909.
Opuntia blakeana Rose, Contr. U. S. Nat. Herb. 12: 402. 1909.
Opuntia zuniensis Griffiths, Bull. Torr. Club 43: 86. 1916. (From the description.)

Low, usually prostrate, with some branches ascending; joints usually longer than broad, 10 to 15 cm. long; areoles rather remote, the lower ones often spineless; spines 1 to 4, those on the sides of the joints more or less reflexed, somewhat flattened, usually rather stout, brown, sometimes darker at base, or often nearly white throughout, the longer ones 5 to 6 cm. long; glochids numerous, yellow to brown; flowers 5 cm. broad, yellow; ovary short; fruit 30 to 35 mm. long, much contracted at base.

Type locality: About Santa Fé and on the Rio Grande, New Mexico.

Distribution: Texas to Arizona and Chihuahua.

We have referred to *Opuntia phaeacantha* the common low, bushy *Opuntia* with small joints, brown spines, and yellow flowers of the Southwest; we formerly regarded it as composed of several species, and others have followed our lead; but we are unable to draw any distinct lines after a study of much additional herbarium and greenhouse material. Dr. Rose has collected a large series of specimens from the Southwest, especially from the type localities, but his specimens seem to bridge over differences which before seemed tangible; cited differences appear to be racial rather than specific.

Opuntia blakeana, which is found west of the Rocky Mountains, one would expect to be different. It is characterized by small obovate joints, rather short spines, small yellow flowers purple at center.

Opuntia chihuahuensis, which was first described from Mexican specimens, if it belongs here, is in the southern range of *O. phaeacantha*. It, too, has yellow flowers with red centers, rather large joints, and long, slender spines. Mr. Wooton is of the opinion that to *O. chihuahuensis* is to be referred the common, low, brown species from El Paso, which includes the specimens of G. R. Vasey, which Coulter called *Opuntia mesacantha oplocarpa*. This long-spined form extends north throughout eastern New Mexico to southeastern Colorado. With the latter form Mr. Wooton believes *Opuntia camanchica* belongs. If we take this broad view of the limits of this species we are forced to include *Opuntia toumeyi*, although it is much larger than *O. blakeana*, and was considered by Dr. Rose to be different.

Opuntia mesacantha sphaerocarpa Wooton and Standley (Contr. U. S. Nat. Herb. 19: 446. 1915) is a mistake, *O. mesacantha oplocarpa* being intended.

Opuntia rubrifolia Engelmann in Coulter (Contr. U. S. Nat. Herb. 3: 424. 1896), from St. George, Utah, belongs in this series if E. W. Nelson's No. 156, from the same place has been properly determined as such. The type specimen of *O. rubrifolia* has, apparently, been lost.

The following varieties of *Opuntia camanchica* have been offered by Haage and Schmidt in their catalogues: *albispina* (Trade Seed Cat. 104. 1911–1912); *orbicularis*, *rubra*, and *salmonea* (all in Haupt-Verzeichnis 1908: 228. 1908). Under *O. camanchica* has been mentioned also variety *luteo-staminea* (Cat. Darrah Succ. Manchester 53. 1908).

Opuntia eocarpa Griffiths (Proc. Biol. Soc. Washington 29: 11. 1916), also *O. recurvospina* Griffiths (Proc. Biol. Soc. Washington 29: 12. 1916) and possibly *O. superbospina* Griffiths (Proc. Biol. Soc. Washington 29: 13. 1916) and *O. caesia* Griffiths (Proc. Biol. Soc. Washington 29: 13. 1916) are of this relationship.

*Opuntia microcarpa** Engelmann (Emory, Mil. Recon. 158. f. 7. 1848) and *O. violacea* Engelmann (Emory, Mil. Recon. 158. f. 8. 1848) were described from drawings brought

*Since the above was written Dr. Griffiths (Bull. Torr. Club, 43: 527) has published a detailed account of this species, which he regards as distinct; it inhabits southern Arizona.

M. E. Eaton del.

1. Flowering joints of *Opuntia atrispina*. 2. Flowering joint of *Opuntia phaeacantha*.
3. Upper part of joint of *Opuntia engelmannii*. (All natural size.)

back from the Southwest by W. H. Emory. They can never be critically identified, but are probably of this relationship.

Illustrations: Engler and Prantl, Pflanzenfam. 3^{6a}: f. 57, C; Förster, Handb. Cact. ed. 2. f. 141; Illustr. Fl. 2: f. 2530; ed. 2. 2: f. 2989; Pac. R. Rep. 4: pl. 9, f. 1 to 5; pl. 22, f. 12 to 15; Wiener Illustr. Gartenz. 10: f. 115, all as *Opuntia camanchica;* N. Mex. Agr. Exp. Sta. Bull. 78: pl. [7], as *Opuntia chihuahuensis;* Contr. U. S. Nat. Herb. 12: pl. 55, as *Opuntia blakeana;* Cact. Mex. Bound. pl. 75, f. 9 to 13.

Plate XXV, figure 2, represents a flowering joint of a plant sent from Tucson, Arizona, in 1916, by Dr. MacDougal.

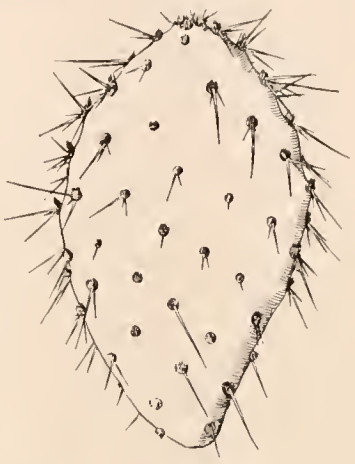


FIG. 183.—Opuntia covillei. ×0.4.

146. **Opuntia mojavensis** Engelmann, Proc. Amer. Acad. 3: 293. 1856.

Prostrate, with suborbicular joints; pulvini remote, with large yellow bristles; spines 2 to 6, stout and annulate, acutely angular and compressed, more or less curved, reddish brown, paler toward tip, 2.5 to 6 cm. long, 1 to 3 smaller, slenderer, pale ones added below; fruit oblong, 4.5 cm. long.

Type locality: On the Mojave, west of the Colorado, California.

Distribution: Known only from the type locality.

The fragmentary type specimen has been examined; we have been unable to refer any other specimens to this species, which is thus very imperfectly understood.

Illustration: Pac. R. Rep. 4: pl. 9, f. 6 to 8.

147. **Opuntia covillei** Britton and Rose, Smiths. Misc. Coll. 50: 532. 1908.

Opuntia megacarpa Griffiths, Rep. Mo. Bot. Gard. 20: 91. 1909.

Opuntia rugosa Griffiths, Proc. Biol. Soc. Washington 27: 27. 1914.

Bushy plants, usually growing in dense thickets; joints orbicular to obovate, 10 to 20 cm. long or more, pale green, sometimes purplish, slightly glaucous; areoles 2 to 4 cm. apart; spines several from an areole, slender, unequal, the longest ones 6 cm. long, white when young, brownish when old; flowers large, yellow.

Type locality: San Bernardino, California.

Distribution: Interior valleys of southern California.

FIG 184.—Opuntia covillei.

Opuntia covillei and *O. vaseyi* grow in the same valleys, often in adjoining colonies, and while hybrids may occur, the two species could easily be distinguished. When growing

in conjunction, *O. covillei* is considerably taller, has joints of different color, and has yellow flowers. It has doubtless generally passed as *Opuntia occidentalis*, but that is a much larger, stouter plant, with strong, more or less flattened spines, and is common along the coast.

Figure 183 represents a joint of the plant sent by Dr. MacDougal from Elsinore, California, in 1913; figure 184 is from a photograph of a specimen collected by Mr. S. B. Parish from near the type locality in 1916.

148. **Opuntia vaseyi** (Coulter) Britton and Rose, Smiths. Misc. Coll. **50**: 532. 1908.

Opuntia mesacantha vaseyi Coulter, Contr. U. S. Nat. Herb. **3**: 431. 1896.
Opuntia rafinesquei vaseyi Schumann, Gesamtb. Kakteen 717. 1898.
Opuntia humifusa vaseyi Heller, Cat. N. Amer. Pl. ed. 2. 8. 1900.
Opuntia magenta Griffiths, Rep. Mo. Bot. Gard. **19**: 268. 1908.
Opuntia rubiflora Davidson, Bull. South. Calif. Acad. **15**: 33. 1916.

Plants low, the lower stems spreading at base, but some of the branches erect and 4 to 7 joints high; joints thick, small (usually 10 to 12 cm. long), ovate, pale green, somewhat glaucous; areoles rather large, 2 to 3 cm. apart, bearing 1 to 3 spines; spines porrect, usually short (rarely 2 cm. long), grayish brown or bright brown, whitish or yellowish towards the tips, somewhat flattened; young joints bright green, thickish, bearing short purplish leaves and a single brownish spine from an areole; flowers deep salmon, almost a red-salmon, from the very first; ovary globular to shortly oblong; areoles few, mostly towards the top of the ovary, spineless but with a few brown glochids; fruit globular to shortly oblong, 4 to 5 cm. long, deep purple, truncate at apex, with few areoles, the pulp sweetish but hardly edible; umbilicus broadly depressed.

Type locality: Cited as Yuma, Arizona, presumably erroneously.

Distribution: San Bernardino and Orange Counties, southern California.

Even from a moving train this species is distinguishable from its relatives by the color of its flowers. It forms great thickets along the Southern Pacific Railroad north of Los Angeles, either alone or interspersed with one or more other species, and it is also common in the San Bernardino Valley toward the Cajon Pass where it forms great thickets either alone or with *Opuntia covillei*. Considerable quantities were seen also on hills near Riverside, and it was found cultivated in the cactus garden at Riverside and in the Soldiers' Home Grounds at Santa Monica.

Illustration: Bull. South. Calif. Acad. **15**: 32, as *Opuntia rubiflora*.

Figure 185 represents a joint of the plant collected by Dr. Rose at Fernando, California, in 1908.

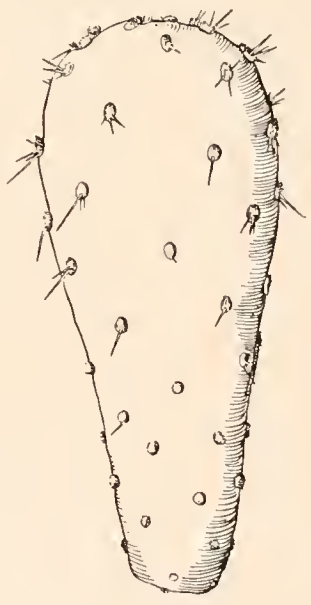


Fig. 185.—Opuntia vaseyi. ×0.5.

149. **Opuntia occidentalis** Engelmann and Bigelow, Proc. Amer. Acad. **3**: 291. 1856.

Opuntia lindheimeri occidentalis Coulter, Contr. U. S. Nat. Herb. **3**: 421. 1896.
Opuntia engelmannii occidentalis Engelmann in Brewer and Watson, Bot. Calif. **1**: 248. 1876.*
Opuntia demissa Griffiths, Rep. Mo. Bot. Gard. **22**: 29. 1912.

Erect or spreading, often 1 meter high or more, forming large thickets; joints large, obovate to oblong, 2 to 3 dm. long; areoles remote; spines 2 to 7, stout, unequal, the longest ones 4 to 5 cm. long, more or less flattened, brown or nearly white, sometimes wanting; shorter spines often white; glochids often prominent, brown; flowers yellow, large, including the ovary often 10 to 11 cm. long; fruit large, purple.

Type locality: Western slopes of the California Mountains, between San Diego and Los Angeles.

Distribution: Southwestern California and northern Lower California and adjacent islands.

In their description of this species, Engelmann and Bigelow state that it was found on the western slope of the California Mountains near San Diego and Los Angeles. In the

*Coulter refers this name to Pac. R. Rep. **4**: errata, 3, 1856, but no formal name is published there.

Engelmann herbarium are the two original sheets. One of these comes from the "Mountain Valleys of San Pasquel and Santa Isabel," northeast of San Diego. This consists of a single flower and a small piece of a joint containing three bunches of spines; we doubt if this can be identified. The other comes from near Los Angeles and consists of a large pad and fruit with seeds. The spines are dark brown or nearly black. This specimen appears to be the one figured in the Pacific Railroad Report and may very properly be taken as the type of the species.

There is much uncertainty regarding the range of this species, some referring it to the interior valleys of California. An examination, however, of the type material, and a study of the living plants in southern California by Dr. Rose, convince us that the coastal opuntias can not all be referred to *O. littoralis* as is sometimes done, but a part belongs to *O. occidentalis*. The limits of the latter species, and its distribution, are not well defined.

Of this relationship is to be considered *Opuntia semispinosa* Griffiths (Bull. Torr. Club 43: 89. 1916), which the author describes as a common, conspicuous species in the coastal region of California.

Illustrations: N. Mex. Agr. Exp. Sta. Bull. 60: pl. 3, f. 2; Pac. R. Rep. 4: pl. 7, f. 1, 2; pl. 22, f. 10; Rep. Mo. Bot. Gard. 22: pl. 8, this last as *Opuntia demissa*.

Figure 186 is from a plant collected on Santa Catalina Island, California, by Mr. S. B. Parish in 1916.

FIG. 186.—Opuntia occidentalis.

150. Opuntia engelmannii Salm-Dyck in Engelmann, Bost. Journ. Nat. Hist. 6: 207. 1850.

Opuntia engelmannii cyclodes Engelmann, Proc. Amer. Acad. 3: 291. 1856.
Opuntia lindheimeri cyclodes Coulter, Contr. U. S. Nat. Herb. 3: 422. 1896.
Opuntia dillei Griffiths, Rep. Mo. Bot. Gard. 20: 82. 1909.
Opuntia arizonica Griffiths, Rep. Mo. Bot. Gard. 20: 93. 1909.
Opuntia wootonii Griffiths, Rep. Mo. Bot. Gard. 21: 171. 1910.
Opuntia cyclodes Rose, Contr. U. S. Nat. Herb. 13: 309. 1911.
Opuntia gregoriana Griffiths, Rep. Mo. Bot. Gard. 22: 26. 1912.
Opuntia valida Griffiths, Proc. Biol. Soc. Washington 27: 24. 1914.
Opuntia confusa Griffiths, Proc. Biol. Soc. Washington 27: 28. 1914.
Opuntia magnarenensis Griffiths, Proc. Biol. Soc. Washington 29: 9. 1916.
Opuntia expansa Griffiths, Proc. Biol. Soc. Washington 29: 14. 1916.

Originally described as erect and up to 2 meters high, but more properly a widely spreading bush, usually without a definite trunk; joints oblong to orbicular, 2 to 3 dm. long, thick, pale green; areoles distant, becoming large and bulging; spines usually more or less white, with dark red or brownish bases and sometimes with black tips, usually 3 or 4, sometimes only 1, or entirely wanting from the lower areoles, but on old joints 10 or more, usually somewhat porrect or a little spreading, but never reflexed, the larger ones much flattened, the longest one 5 cm. long; leaves subulate, about 15 mm. long; glochids numerous, brown with yellowish tips; flowers large, yellow; fruit 3.5 to 4 cm. long, red; seeds small, 3 to 4 mm. broad.

Type locality: From El Paso to Chihuahua.
Distribution: Chihuahua, Durango, Sonora, Arizona, New Mexico, and Texas.

An examination of the plant collected by Wislizenus (No. 223) north of Chihuahua, now in the herbarium of the Missouri Botanical Garden and labeled by Dr. Engelmann as *O. engelmannii* Salm-Dyck, shows that this species is of Schumann's series *Fulvispinosae* (our series *Phaeacanthae*) rather than series *Tunae*.

Opuntia engelmannii has been more confused than any other species of *Opuntia*. Salm-Dyck, who first studied the species, doubtless had but a single specimen before him, and this or a duplicate is now in the herbarium of the Missouri Botanical Garden. This type specimen came from near Chihuahua City, from which place Dr. Rose has collected identical material. Dr. Engelmann, who published Salm-Dyck's name, described the plant as erect and 5 to 6 feet high, giving its range from Chihuahua City to Texas. These remarks of his were doubtless based on notes of Dr. Wislizenus, who collected the type, and must have included more than one species; as Engelmann says it is both cultivated and wild, the cultivated plants doubtless referring to some of the many forms grown about towns and ranches. In 1852 Engelmann extends the distribution of the species westward to the Pacific Ocean, referring especially to a San Diego specimen. In 1856 he refers here his previously described species *O. lindheimeri*, and extends the range eastward to the mouth of the Rio Grande and to lower Mexico. Coulter brought all this material together under *O. lindheimeri* and four varieties.

An examination of herbarium and greenhouse specimens shows that at least half a dozen species have been passing under the name of *O. engelmannii*. While certain varieties and specimens are evidently to be excluded from the species, we are still uncertain as to its specific limits. It is quite common about Chihuahua City and extends to Monterey and Saltillo or is represented there by a near ally, while Mr. E. O. Wooton would refer here plants of southern New Mexico, and we are including large, bushy opuntias from Arizona.

Dr. Rose was inclined at one time to separate the Tucson plant, which seems to have some just claims for specific recognition, but there is a mass of herbarium material which seems to connect this with the true *O. engelmannii*.

Opuntia engelmannii monstrosa (Cat. Darrah Succ. Manchester 54. 1908) is doubtless one of the abnormal forms so common among the flat-jointed opuntias.

Opuntia cyclodes, first found by Bigelow near Anton Chico, New Mexico, is certainly of this relationship. The characters of orbicular joints, of small fruit and of stout, usually solitary spines, originally assigned to it, are not constant, for it often has obovate to oblong joints bearing as many as four slender spines and large fruit.

In 1913 Dr. Rose explored the upper Pecos, especially about Anton Chico, near the type locality, where he collected specimens similar to the Bigelow plant, but these grade into more spiny forms, some bearing as many as five spines at an areole, usually yellow, especially distally, and more slender than in typical *O. engelmannii*. From the same type locality, and associated with *O. cyclodes*, is *O. expansa* Griffiths, which has more and whiter spines than the typical form, although they are sometimes yellowish with brown bases. *O. dillei* Griffiths is also related to *O. cyclodes*, but the spines are fewer; Dr. Griffiths states, however, that more spines develop on cultivated plants.

Illustrations: Pac. R. Rep. 4: pl. 8, f. 1; pl. 22, f. 8, 9, all as *Opuntia engelmannii cyclodes;* Rep. Mo. Bot. Gard. 20: pl. 4, in part, as *Opuntia dillei*. Ariz. Agr. Exp. Sta. Bull. 67: pl. 7, f. 1; Rep. Mo. Bot. Gard. 20: pl. 10; Safford, Ann. Rep. Smiths. Inst. 1908: pl. 10, f. 3, 6, all as *Opuntia arizonica*. Rep. Mo. Bot. Gard. 21: pl. 26, in part, 27, both as *Opuntia wootonii*. Rep. Mo. Bot. Gard. 22: pl. 3, this last as *Opuntia gregoriana*. Standley, Ann. Rep. Smiths. Inst. 1911: pl. 2; Bull. Torr. Club 32: pl. 10, f. 10 to 13; Cact. Journ. 2: 147; Cact. Mex. Bound. pl. 75, f. 1 to 4; Cycl. Amer. Hort. Bailey 3: f. 1547; Gard. Chron. III. 30: f. 123; N. Mex. Agr. Exp. Sta. Bull. 78: pl. [5, 6].

Plate XXV, figure 3, represents a flowering joint of a plant sent from Arizona by Dr. MacDougal in 1902.

151. Opuntia discata Griffiths, Rep. Mo. Bot. Gard. **19**: 266. 1908.

Opuntia gilvescens Griffiths, Rep. Mo. Bot. Gard. 20: 87. 1909.
Opuntia riparia Griffiths, Proc. Biol. Soc. Washington 27: 26. 1914.

Plants bushy, spreading, sometimes 15 dm. high; joints thick, orbicular to broadly obovate, 2.5 dm. in diameter or less, pale bluish green, somewhat glaucous; areoles rather few, distant, in age becoming very large, hemispheric, filled with short brown wool; spines usually 2 to 4, sometimes 7 or more in old areoles, 2 cm. long or more, grayish with dark bases, somewhat flattened; flowers large, 9 to 10 cm. broad, light yellow, darker near the center; style white; stigma-lobes green; fruit magenta, pyriform, 6 to 7 cm. long.

Type locality: Foothills of Santa Rita Mountains, Arizona.

Distribution: Foothills and high mesas of southern Arizona and northern Sonora.

Illustrations: Rep. Mo. Bot. Gard. 20: pl. 2, f. 5; pl. 7; pl. 13, f. 6, all as *Opuntia gilvescens;* Amer. Garden 11: 469, this last as *Opuntia angustata*. Ariz. Agr. Exp. Sta. Bull. 67: pl. 1, f. 2; Bull U. S. Dept. Agr. 31: pl. 3, f. 2; Rep. Mo. Bot. Gard. 19: pl. 27, in part.

Plate XXIV, figure 2, is from a photograph taken by Dr. MacDougal in the Tortolita Mountains, Arizona, in 1916; *Opuntia discata* is the plant shown in left foreground.

152. Opuntia rastrera Weber, Diet. Hort. Bois 896. 1898.

?Opuntia lucens Griffiths, Rep. Mo. Bot. Gard. 19: 269. 1908.

Creeping plant; joints circular to obovate, the largest 2 dm. in diameter; spines white, several from an areole, the longest 4 cm. long; glochids yellow; flowers yellow; fruit purple, acid, obovoid.

Type locality: San Luis Potosí, Mexico.

Distribution: The type locality and vicinity.

This species was very briefly described in 1898 by Dr. Weber, who states that it is quite distinct from *O. tuna*, the Jamaican species. Schumann, who treats it in a note under *O. tuna*, states that it is a well-differentiated species from Mexico.

From descriptions we are referring here *O. lucens* Griffiths, also described from San Luis Potosí specimens. Dr. Griffiths states that his *O. lucens* is related to *O. engelmannii*, but has a different habit; he says it is called cuija by the Mexicans, but that it is very different from *Opuntia cuija*.

Series 12. ELATIORES.

Tall species, with flat, broad, persistent joints, the areoles bearing acicular, setaceous, or subulate brown spines, or some species spineless. We know about twelve species, most of them South American, with one in Florida (see Appendix p. 222), possibly one (*O. fuliginosa*) in Mexico.

Key to Species.

Joints very spiny.
- Spines not banded.
  - Areoles surrounded by a purple blotch ..... 153. *O. brunnescens*
  - Areoles not surrounded by a purple blotch.
    - Spines setaceous; petals yellow ..... 154. *O. galapageia*
    - Spines, when present, acicular or subulate; petals mostly red or orange.
      - Joints strongly undulate; spines short, stout ..... 155. *O. delaetiana*
      - Joints not undulate or scarcely undulate.
        - Joints bluish green, glaucous ..... 156. *O. bergeriana*
        - Joints bright green, not glaucous or slightly glaucous
          - Spines, at least on young joints, acicular, slender.
            - Spines, when present, dark brown or blackish; joints dull ..... 157. *O. elatior*
            - Spines light brown to straw-colored.
              - Spines up to 5 cm. long; joints shining ..... 158. *O. hanburyana*
              - Spines 3 cm. long or less; joints dull.
                - Flowers 12 to 15 mm. wide; spines 1 to 4 at an areole or wanting ..... 159. *O. quitensis*
                - Flowers 5 to 6 cm. wide; spines up to 10 at an areole ..... 159*a*. *O. soederstromiana*
          - Spines subulate, stout; joints shining ..... 160. *O. schumannii*
    - Spines acicular; petals yellow; joints shining [in this series?] ..... 161. *O. fuliginosa*
- Spines distinctly banded; joints dark green, obscurely glaucous ..... 161*a*. *O. zebrina*

Joints usually spineless.
- Bushy, 1 to 2 meters high; flowers rose ..... 162. *O. boldinghii*
- Erect, 3 to 4 meters high; flowers orange-red ..... 163. *O. distans*

153. **Opuntia brunnescens** sp. nov.

Usually low and prostrate, sometimes 1 meter high, without a definite trunk, usually forming a bushy clump; joints oblong to orbicular, 15 to 30 cm. long, smooth, dull green, except the purple blotches about the prominent areoles; spines 2 to 5, brownish, porrect or pointing forward, up to 4.5 cm. long, stout, sometimes twisted.

Hills about the city of Córdoba, Argentina, where it was collected by Rose and Russell, September 8, 1915 (No. 21029).

This species is very common on the dry hills about Córdoba, where it is often associated with *Opuntia sulphurea*. It apparently extends northward into Jujuy.

Figure 187 represents a joint of the type specimen above cited; figure 188 shows its fruit collected by Dr. Shafer (No. 78).

154. **Opuntia galapageia** Henslow, Mag. Zool. and Bot. 1: 467. 1837.

Opuntia myriacantha Weber, Dict. Hort. Bois 894. 1898.
Opuntia helleri Schumann in Robinson, Proc. Amer. Acad. 38: 180. 1902.
Opuntia insularis Stewart, Proc. Calif. Acad. IV. 1: 113. 1911.

Sometimes low and creeping, but often becoming very large, 5 to 10 meters high, with a large top either open or very compact and rounded; trunk at first very spiny and made up of flat joints set end to end, with the short axis of each joint at right angles to that of the adjacent joint, in time becoming terete, and when old nearly naked, 3 to 13 dm. in diameter; bark of old trunks smooth, brown, peeling off in thin layers; joints oblong to orbicular, usually very large, 1.5 to 3.5 dm. long, very spiny; areoles large, often prominent on the trunk, there especially forming knobs bearing numerous spines; spines extremely variable, but nearly all yellowish brown; areoles on young, vigorous plants very stout and rigid, very unequal, the longest 7 to 8 cm. long; joints of old plants bearing more or less pungent bristles or sometimes very weak soft hairs instead of spines, while the spines from the trunks often are very stout and sometimes 40 in a cluster; flowers yellow, 7.5 cm. broad; ovary more or less tuberculate; fruit greenish, sometimes borne in the ends of joints, more or less spiny; seeds large, 5 to 6 mm. broad, white, covered with soft hairs.

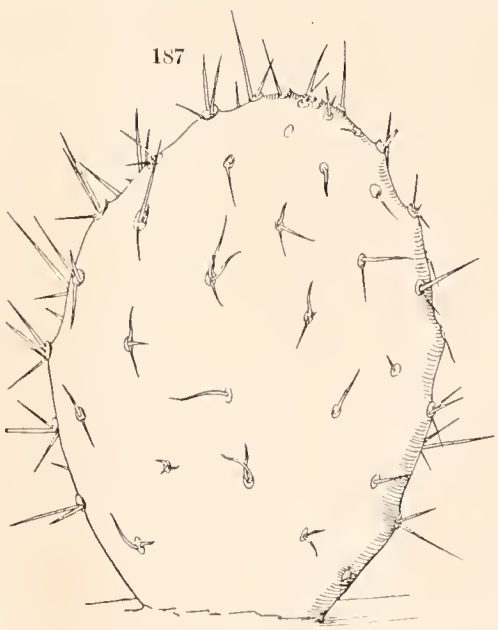


FIG. 187.—O. brunnescens. ×0.4.

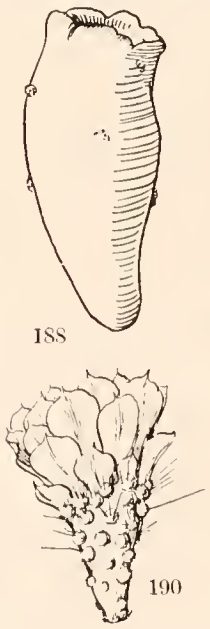


FIG. 188.—Fruit of O. brunnescens. ×0.9.

FIG. 190.—Flower of same. ×0.75

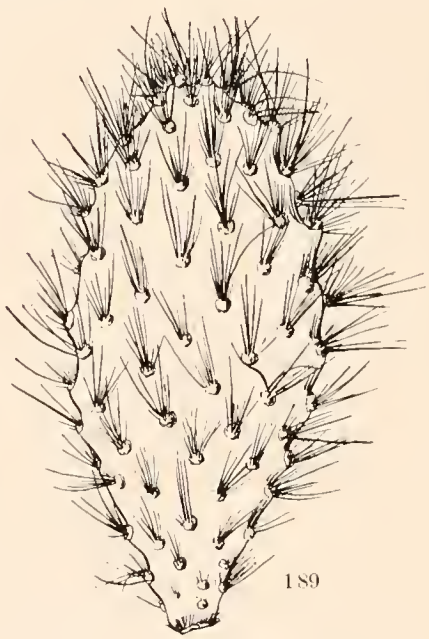


FIG. 189—Joint of O. galapageia.

Type locality: Galápagos Islands.

Distribution: Very common, often forming forests, on the Galápagos Islands.

We have here combined the four species reported from the Galápagos Islands, while Alban Stewart, in his admirable paper on the botany of these islands, not only recognizes four species, but describes a fifth without specific name. He also has fourteen full-page

illustrations showing fine habit views of the Galápagos *Opuntia*. The early descriptions of this species were very inaccurate and, as pointed out by Mr. Stewart, the characters assigned to its fruit are those of a Cereus-like plant. Mr. Stewart visited the Galápagos Islands in 1905–1906 and brought back a remarkable series of photographs and specimens. Through the kindness of Miss Alice Eastwood, Curator of Botany in the California Academy of Sciences, we have been able to study this material. It consists of about forty sheets of well-preserved joints with a few flowers and fruits. These, in connection with the pub-

FIG. 191.—Opuntia galapageia. ×0.75.

lished illustrations, show a great range of variation in habit, armament of joints, and character of spines. While these differences are very marked, they are similar to what is sometimes met with in other opuntias, such as *O. gosseliniana* and *O. leucotricha*, or in certain Peruvian and Chilean types of *Cereus* relatives; indeed, in a number of cacti which live under intense desert influences, most diverse forms in the same species are often produced. The habit-character in this species seems to be of little value, according to Mr.

Stewart himself, for he calls attention to procumbent and arborescent forms of *O. galapageia*, while the greatest range of spine characters is shown between the young plants and old ones and between the trunk and the joints. The specimen which Mr. Stewart has made the type of his *Opuntia insularis* is quite different from all the others, and yet one can easily believe that intergrades could be found; his species is described without flowers or fruit. Mr. Stewart states that this *Opuntia* forms the principal article of food for the Galápagos land tortoise. Its trunk becomes thicker than that of any other known species of the genus.

Illustrations: Gard. Chron. III. 24: f. 75; Mag. Zool. and Bot. 1: pl. 14, f. 2; Proc. Calif. Acad. IV. 1: pl. 7, f. 2; pl. 8; pl. 9, f. 2; pl. 10 to 12. Gard. Chron. Ser. III. 27: f. 56; Proc. Calif. Acad. IV. 1: pl. 7, f. 1; pl. 13, f. 2; pl. 16 to 18, all as *Opuntia myriacantha*. Proc. Calif. Acad. IV. 1: pl. 13, f. 1; pl. 14, the last two as *Opuntia helleri*. Proc. Calif. Acad. IV. 1: pl. 9, f. 1; pl. 15, the last two as *Opuntia insularis*.

Figure 189 represents a joint of the plant collected by Robert E. Snodgrass and Edmund Heller on Wenman Island, Galápagos, on the Hopkins-Stanford Expedition (type of *Opuntia helleri* Schumann), drawn from the herbarium specimen in the Gray Herbarium; figure 190 is of a flower of the same plant; figure 191 is from a photograph of an herbarium specimen collected by Alban Stewart.

155. **Opuntia delaetiana** Weber in Vaupel, Blühende Kakteen 3: pl. 148. 1913.

Opuntia elata delaetiana Weber in Gosselin, Bull. Mus. Hist. Nat. Paris 10: 392. 1904.

Joints oblong, 25 cm. long, 8 cm. broad, bright green, at first thin and spineless, the margin strongly undulate; areoles large, bearing 3 to 5 straight, rose-colored or yellowish brown spines up to 4 cm. long; leaves subulate, about 4 mm. long; glochids wanting in young areoles, later appearing numerous and brown; flower-buds rounded at the apex; outer sepals orbicular, obtuse, red; flower rotate, 5 to 7 cm. broad, orange-colored; stigma-lobes white; fruit oblong or pyriform, red, 5 to 7 cm. long, 3 to 5 cm. in thickness.

Type locality: Paraguay.

Distribution: Paraguay and northeastern Argentina.

The plant was collected by Dr. Thomas Morong at Asunción, Paraguay, in 1888, and referred in his list of plants collected in Paraguay (Annal. N. Y. Acad. Sci. 7: 121. 1892) to *O. nigricans* Haworth; Dr. Shafer found it in 1917 in waste places and in hedge-rows about Concordia and Posados, Argentina. This species may more properly belong in our series *Elatae* than in *Elatiores*.

Illustration: Blühende Kakteen 3: pl. 148.

Figure 192 is copied from the illustration above cited.

Fig. 192.—Opuntia delaetiana.

156. **Opuntia bergeriana** Weber in Berger, Gard. Chron. III. 35: 34. 1904.

Growing singly or in dense thickets, often 1 to 3.5 meters high and having a trunk 3 to 4 dm. in diameter, with a large, spreading top, or clambering over walls and rocks; joints narrowly oblong, sometimes 2.5 cm. long, when young often quite narrow, bright green, but becoming dull and somewhat glaucous; areoles rather distant, on old joints 2 to 4 cm. apart, filled with short gray wool; spines 2 or 3, rarely 5, unequal, the longest one 3 to 4 cm. long and somewhat flattened, more or less brownish at base, sometimes yellowish, porrect, or somewhat turned downward; leaves 2 to 3 mm. long, fugacious; glochids yellow but sometimes turning brown, rather prominent, forming a half circle in the upper part of the areole; areoles circular, when young filled with light brown wool in the center and white in the outer region; flowers numerous, showy, deep red;

M. E. Eaton del

1. Flowering joint of *Opuntia bergeriana*.
2. Flowering joint of *Opuntia elatior*.
3. Flowering joint of *Opuntia boldinghii*.
4, 5 Joints of *Opuntia elata*.

(All natural size.)

some joints bearing 20 or more; petals 2.5 cm. long, mucronate; filaments numerous, scarlet-rose; stigma-lobes 6, green; fruit small, 3 to 4 cm. long, red, not edible; seeds few, flattened, 5 mm. broad.

Type locality: Described from cultivated specimens.

Distribution: Not known in the wild state, but now very common on the Riviera, northern Italy, forming large thickets.

Mr. Berger would place this species next to *O. nigricans*, which we now call *O. elatior*. This species was named for Alwin Berger, formerly curator of the Hanbury Garden at La Mortola, Italy, who sent material to the late Dr. Weber, from which the species was described. The species is quite common on the Riviera and has run wild in many places, especially about Bordighera, Italy. It produces a great abundance of flowers in May, but blooms more or less throughout the year.

Opuntia ledienii (Berger, Hort. Mortol. 233. 1912), unpublished, is referred here.

Illustrations: Gard. Chron. III. 35: f. 14; Monatsschr. Kakteenk. 16: 156.

Plate XXVI, figure 1, represents a flowering joint of a plant sent from La Mortola, Italy, to the New York Botanical Garden in 1906.

157. Opuntia elatior Miller, Gard. Dict. ed. 8. No. 4. 1768.

Cactus nigricans Haworth, Misc. Nat. 187. 1803.
Opuntia nigricans Haworth, Syn. Pl. Succ. 189. 1812.
Cactus elatior Willdenow, Enum. Hort. Berol. Suppl. 34. 1813.
Cactus tuna nigricans Sims, Curtis's Bot. Mag. 38: pl. 1557. 1813.
Cactus tuna elatior Sims, Curtis's Bot. Mag. 38: under pl. 1557. 1813.
Cactus pseudococcinellifer Bertoloni, Excerpta Herb. Bonon. 11. 1820.

Plants densely bushy-branched, up to 5 meters high; joints obovate to oblong or suborbicular, olive-green, 1 to 2 dm. or even 4 dm. long; leaves 4 mm. long, green with reddish tips; areoles 2 to 4 cm. apart; spines 2 to 8, acicular, mostly terete, dark brown, 2 to 4 cm. or even 7 cm. long; flowers about 5 cm. broad; petals dark yellow striped with red or sometimes salmon-rose, with mucronate tips; filaments numerous, pink or red; style nearly white; stigma-lobes 5, green; ovary ovoid, deeply umbilicate, its areoles either with or without spines; fruit obovoid, truncate when mature, reddish, the pulp dark red; seeds about 4 mm. broad.

Type locality: Unknown.

Distribution: Common or frequent in Curaçao, Venezuela, Colombia, and Panama, escaped from cultivation in Australia. *O. nigricans* has been referred to Mexico, but doubtless wrongly, unless cultivated there. Plants brought by Dr. Howe from Tobogilla Island, Panama, have narrowly obovate joints.

The early history of this species and its various synonyms are rather confusing. Dillenius figured *Opuntia elatior* and this name was taken up by Miller in 1768. There is some doubt as to its native home, but it probably came from northern South America, or possibly Curaçao. *Opuntia nigricans*, also referred here, was described by Haworth from cultivated specimens; plate 1557 of Curtis's Botanical Magazine was made from Haworth's specimen and may be considered typical.

Introduced into cultivation in Europe about 1793.

Illustrations: Loudon, Encycl. pl. ed. 3. f. 6877, as *Cactus elatior;* Curtis's Bot. Mag. 38: pl. 1557, this last as *Cactus tuna nigricans;* Dillenius, Hort. Elth. pl. 294, this as *Tuna elatior*, etc.; Agr. Gaz. N. S. W. 23: pl. opp. 208; pl. opp. 210, both these as *Opuntia nigricans;* Journ. Hort. Home Farm. III. 60: 30, this as *Opuntia occidentalis*.

Plate XXVI, figure 2, shows a flowering joint of a specimen obtained by Dr. Britton and Dr. Shafer in Curaçao in 1913.

158. Opuntia hanburyana Weber in Berger, Gard. Chron. III. 35: 34. 1904.

Bushy, 1 to 2 meters high, somewhat straggling; joints narrowly oblong, about 3 dm. long, bright green; leaves subulate, 4 to 5 mm. long; areoles closely set, filled with brown or blackish wool; spines several, spreading, acicular, somewhat flattened and twisted, yellowish brown, the longest 3 cm. long; flowers widely spreading, rather small; fruit small.

Type locality: Described from cultivated plants.

Distribution: Not known in the wild state.

The species commemorates Sir Thomas Hanbury, who, through his extensive garden at La Mortola, Italy, contributed much to botany and horticulture.

Illustration: Gard. Chron. III. 35: f. 15.

Figure 193 represents joints of the plant sent from La Mortola, Italy, in 1913.

159. Opuntia quitensis Weber, Dict. Hort. Bois 894. 1898.

Bushy, sometimes 2 meters high; joints obovate, 1 to 4 dm. long, 8 to 9 cm. broad; areoles small, distant, 2 cm. apart, bearing some white tomentum and short glochids; spines wanting, or 1 to 3, sometimes as many as 4 on old joints, straight, yellowish brown, or nearly white when young, acicular, somewhat flexuous, 2 to 3 cm. long; leaves green, minute, acute; flowers red, 12 to 15 mm. broad; petals erect, obtuse; anthers white; style white, short and thick; stigma-lobes 13, white, about as long as the style; fruit obovoid, red, nearly spineless, about 2 cm. long; seeds about 3 cm. broad.

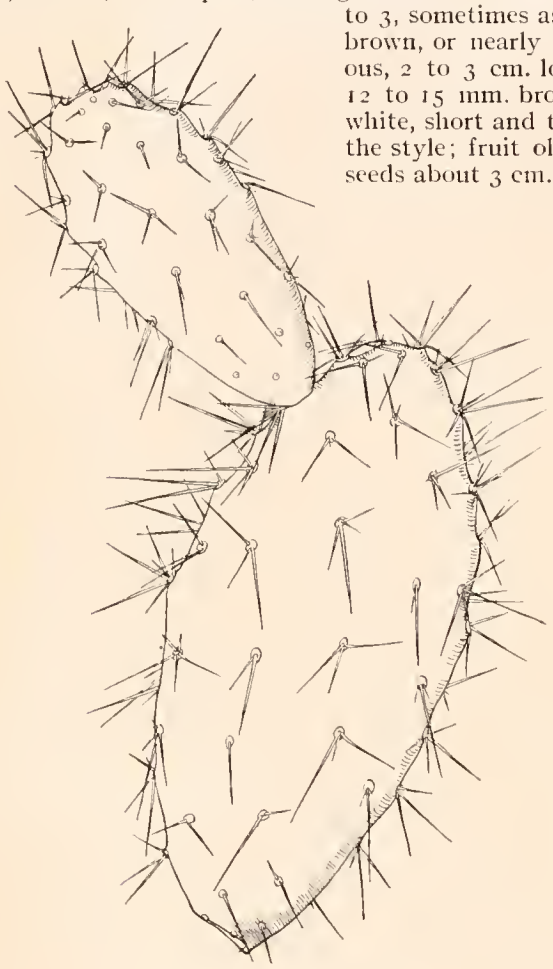


FIG. 193.—O. hanburyana. ×0.5.

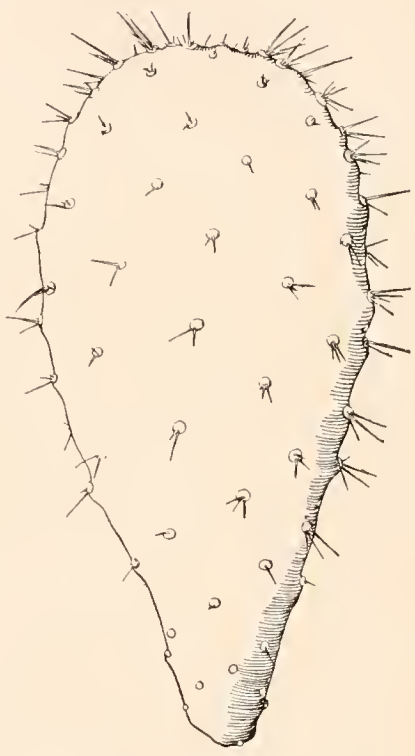


FIG. 194.—O. quitensis. ×0.5.

Type locality: Near Quito, Ecuador.

Distribution: Ecuador.

As observed by Dr. Rose in Ecuador in 1918, this species is very variable in habit, for when grown in the open it is low and bushy with rather small joints, but when growing in thickets it becomes tall and has large joints. About Huigra, where it is very common, it is often spineless, and when the spines are present they are few and weak. In southern Ecuador there is a plant which has small, red flowers like this species, but the joints have stout subulate spines.

Figure 194 represents a joint of a plant obtained in 1901 for the New York Botanical Garden from M. Simon, of St. Ouen, Paris, France.

159*a*. Opuntia soederstromiana sp. nov. (See Appendix, p. 221.)

160. Opuntia schumannii Weber in Berger, Gard. Chron. III. 35: 34. 1904.

Bushy, 1 to 2 meters high; joints obovate to oblong, 1.5 to 2.5 cm. long, dull dark green; areoles distant, medium sized; spines 2 to 10, slightly spreading, very unequal, the longest ones 4.5 cm. long, more or less twisted, flattened, dark brown; glochids few, soon disappearing; flowers 6 cm. long, yellowish to orange, turning in age to dull red; ovary tuberculate, spineless, deeply umbilicate; fruit dark purple, turgid, juicy, deeply umbilicate, 5 cm. long.

Type locality: Not cited.

Distribution: Northern South America; sometimes assigned to Argentina.

Opuntia schumannii is described by Berger as being intermediate between *Opuntia* and *Nopalea*, and according to him, it has long stamens and upright petals; otherwise it has little in common with *Nopalea;* a plant from Santa Clara, Colombia, which agrees with plants of *O. schumannii* from La Mortola, Italy, has a normal *Opuntia* flower.

Illustration: Gard. Chron. III. 35: f. 16.

Plate XXVII, figure 1, represents a fruiting joint of the plant collected by John G. Sinclair at Santa Clara, Colombia, in 1913; figure 2 shows a flower of the same plant.

161. Opuntia fuliginosa Griffiths, Rep. Mo. Bot. Gard. 19: 262. 1908.

Tall, tree-like, 4 meters high or more, much branched; joints orbicular to oblong, 3 dm. long or less, shining; leaves subulate, 8 to 12 mm. long; areoles distant; spines few, rarely as many as 6, dull brown or horn-colored, the longest ones 4 cm. long, slightly twisted; glochids yellow to brown; flowers at first yellow but in age red, 5 to 6 cm. long including the ovary; stigma-lobes yellowish green; fruit pyriform to short-oblong, 3 to 4 cm. long, red; seeds 5 mm. broad.

Type locality: Near Guadalajara, Mexico.

Distribution: Central Mexico.

We refer this species to our series *Elatiores* with hesitation.

Illustration: Rep. Mo. Bot. Gard. 19: pl. 25.

161*a*. Opuntia zebrina Small, Journ. N. Y. Bot. Gard. 20: 35. 1919. (See Appendix, p. 222.)

162. Opuntia boldinghii sp. nov.

Bushy, 2 meters high; joints dull green, somewhat glaucous, obovate, 2 cm. long, spineless or with very short brown spines; leaves conic, red, 2 to 3 mm. long; areoles large, elevated, filled with short brown wool; flowers rose-colored, 5 cm. long; petals obtuse; filaments pink, much shorter than the petals; style nearly white; stigma-lobes yellowish; fruit obovate, 4 cm. long, spineless; seeds 4 mm. in diameter.

Collected by Dr. N. L. Britton and Dr. J. A. Shafer, March 1913, in cultivation on Curaçao (No. 2905, type); also collected by H. Pittier around El Palito, Venezuela, July 2, 1913 (No. 6450), and by Dr. Rose in a hedge at Valencia, Venezuela, October 27, 1916 (No. 21842).

This species is named in honor of Dr. I. Boldingh, a Dutch botanist, author of a valuable descriptive flora of the Dutch West Indian islands.

Plate XXVI, figure 3, shows a flowering joint of a specimen obtained by Dr. Britton and Dr. Shafer in Curaçao in 1913.

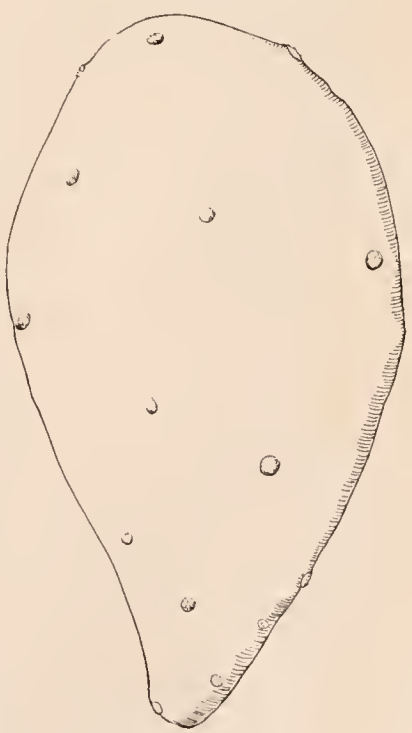


FIG. 195—Joint of O. distans. ×0.4.

163. Opuntia distans sp. nov.

Erect, densely much branched, 3 to 4 meters tall, with a short trunk 1.5 dm. in diameter; joints flat, bluish green when young, grayish green when old, obovate, 2 to 2.5 dm. long, about 1.5 dm. wide and nearly 2 cm. thick, rounded above, narrowed

at the base, glabrous; areoles few, only about 12 on each side of a joint, distant, large, nearly circular, 8 to 10 mm. broad, slightly elevated, bearing many short glochids, but quite spineless; leaves subulate, about 3 mm. long; ovary obconic, 3 to 4 cm. long, bearing a few small areoles; sepals broadly triangular, acute, 6 to 10 mm. long; petals broad, rounded, 1 to 2 cm. long, orange-red.

Distribution: Sandy places, Andalgala, Catamarca, Argentina, J. A. Shafer, December 15, 1916 (No. 7).

A spineless species noteworthy for its few, large, distant areoles. We append it to the series *Elatiores*, but are uncertain as to its real affinity. The large distant areoles forbid associating it with the *Ficus-indicae* or the *Streptacanthae*.

Figure 195 represents a joint of the type specimen.

Series 13. ELATAE.

Erect, tall species, natives of South America, with oblong or oval joints, the brown or white spines, when present, only one or few at each areole, except on the trunk and old joints.

Key to Species.

Joints ovate to broadly oblong or obovate.
- Joints thin, lustrous, light green ..... 164. *O. vulgaris*
- Joints turgid, dull green.
  - Leaves purplish, rigid; joints dark green ..... 165. *O. elata*
  - Leaves green, not rigid; joints pale green.
    - Spines slender, terete ..... 166. *O. cardiosperma*
    - Spines stout, angled, elongated ..... 167. *O. arechavaletai*

Joints narrowly oblong to linear or spatulate.
- Joints oblong to linear; flowers brick-red ..... 168. *O. mieckleyi*
- Joints spatulate; flowers orange ..... 169. *O. bonaerensis*

164. Opuntia vulgaris Miller, Gard. Dict. ed. 8. No. 1. 1768.

Cactus monacanthos Willdenow, Enum. Pl. Suppl. 33. 1813.
Opuntia monacantha Haworth, Suppl. Pl. Succ. 81. 1819.
Cactus urumbeba Vellozo, Fl. Flum. 207. 1825.
Cactus indicus Roxburgh, Fl. Indica 2: 475. 1832.
Cactus chinensis Roxburgh, Fl. Indica 2: 476. 1832.
Opuntia monacantha gracilior Lemaire, Cact. Gen. Nov. Sp. 68. 1839.
Opuntia umbrella Steudel, Nom. ed. 2. 2: 222. 1841.
Opuntia roxburghiana Voigt, Hort. Suburb. Calcutt. 62. 1845.
Opuntia monacantha deflexa Salm-Dyck, Cact. Hort. Dyck. 1849. 66. 1850.
Opuntia lemaireana Console in Weber, Dict. Hort. Bois 894. 1898.

Plant 2 to 4 or even 6 meters high, often with a definite trunk, usually with a large much branched top; trunk cylindric, 1.5 dm. in diameter, either spiny or smooth; joints ovate to oblong, narrowed at base, 1 to 3 dm. long, bright shining green; leaves subulate, 2 to 3 mm. long; areoles filled with short wool; glochids brownish; spines 1 or 2, sometimes more (on the trunk often 10 or more) from an areole, erect, 1 to 4 cm. long, yellowish brown to dark reddish brown; flowers yellow or reddish, 7.5 cm. broad; sepals broad, each with a broad red stripe down the middle; petals golden-yellow, widely spreading; filaments greenish; style white; stigma-lobes 6, white; ovary spineless, 3.5 cm. long; fruit obovoid, 5 to 7.5 cm. long, reddish purple, long-persisting, sometimes proliferous.

Type locality: Type based on an illustration, the origin unknown.

Distribution: Coast and islands of Brazil, Uruguay, and Argentina; in the interior to Paraguay; an escape in Cuba, India, and south Africa and naturalized in Australia; frequently cultivated. According to J. H. Maiden it is found in every state of Australia, but it is not inclined to spread and become a pest.

As has been recently pointed out by Burkill, the *Opuntia vulgaris* of Miller is the same as *O. monacantha* Haworth. *O. vulgaris* was based on Bauhin's figure (Hist. Pl. 1: 154. 1650), which was taken from Lobelius (Icones 2: 241. 1591), and is a tall, branching plant. This species is not to be confused with the low, spreading species of the eastern United States, long known as *O. vulgaris*. (See. p. 127.)

This species is said by Burkill to be distributed over the earth more widely than any other, but our observation in America is that *O. ficus-indica* is by far the most widely spread species.

1. Upper part of fruiting joint of *Opuntia schumannii*.
2. Flower of *Opuntia schumannii*.
3. Flowering joint of *Opuntia vulgaris*.
4. Flowering joint of *Opuntia stricta*.

(All natural size.)

O. vulgaris was one of those most commonly used in the nopalries of India and South Africa in the cochineal industry.

We have referred both of Roxburgh's species here, although Burkill was inclined to refer *Cactus chinensis* to *O. decumana*, which in his sense is *O. ficus-indica*.

Opuntia monacantha variegata (listed in Cat. Darrah Succ. Manchester 57. 1908) is common in cultivation. Some of the joints are normally green; others are more or less blotched with white or yellow, while others may be entirely white or yellow; the leaves are bright red and though small are conspicuous.

Opuntia urumbella Steudel (Nom. ed. 2. 1: 246. 1840), given as a synonym of *Cactus urumbella*, is doubtless a name for this species.

Opuntia deflexa Lemaire (Cact. Gen. Nov. Sp. 68. 1839) was given as a synonym of *O. monacantha gracilior;* while the latter was given as a synonym of *O. elatior deflexa* Salm-Dyck (Cact. Hort. Dyck. 1844. 47. 1845).

Illustrations: Rev. Hort. 41: f. 37; 66: f. 58; Bauhin, Hist. Pl. 1: 154 [=Lobelius, Icones 2: 241], this last as *Opuntia vulgo*, etc. Anal. Mus. Nac. Montevideo 5: pl. 32; Curtis's Bot. Mag. 68: pl. 3911; Dept. Agr. N. S. W. Misc. Publ. 253: pl. [3], [4]; Agr. Gaz. N. S. W. 24: facing p. 864; Edwards's Bot. Reg. 20: pl. 1726; Gard. Chron. III. 30: f. 122, in part; 34: f. 35; Journ. Dept. Agr. Vict. 6: pl. 25; Martius, Fl. Bras. 4^2: pl. 62; Weeds, Pois. Pl. Nat. Al. Vict. pt. 1. pl. [10], [32], all as *Opuntia monacantha;* Amer. Garden 11: 529; Cact. Journ. 1: 167, these last two as *Opuntia monacantha variegata;* Vellozo, Fl. Flum. 5: pl. 32, as *Cactus urumbeba;* De Candolle, Pl. Succ. Hist. 2: pl. 138 [B]; De Tussac, Fl. Antill. 2: pl. 31, these last two as *Cactus opuntia tuna;* Gard. Chron. III. 47: f. 174, this as *Opuntia ficus-indica;* Rümpler, Sukkulenten f. 122, this as *Opuntia tuna;* Addisonia 1: pl. 38.

Plate XXVII, figure 3, represents a flowering joint of a plant presented to the New York Botanical Garden by Mr. Gustav Rix in 1900.

FIG. 196.—O. elata. ×0.4.

FIG. 197.—O. cardiosperma. ×0.4.

165. Opuntia elata Link and Otto in Salm-Dyck, Hort. Dyck. 361. 1834.

An erect plant, 1 meter high or more; joints thick, dark green, oblong, 5 to 25 cm. long, half as broad as long; leaves minute, caducous; areoles remote, large (7 mm. in diameter), filled with short white wool, usually spineless; spines if present only 1 to 3, except on old stems and there more, horn-colored, stiff, sometimes 3.5 cm. long; glochids very tardy in appearing, long persistent; flowers about 5 cm. broad, orange-yellow; petals obtuse, broad; filaments short; stigma-lobes white; fruit oblong, 6 cm. long, spineless, with a truncate umbilicus; seeds 6 mm. broad.

Type locality: In Brazil.

Distribution: Paraguay, but according to Salm-Dyck and Pfeiffer, from Brazil and probably Curaçao; our exploration of Curaçao failed to prove its existence there. It is grown for ornament in Cuba and has there escaped from cultivation in gardens to roadsides and waste grounds.

Schumann did not know where to place this species, but we believe it is most nearly related to *Opuntia vulgaris*.

Plate XXVI, figure 4, represents a flowering joint of a plant given to the New York Botanical Garden by Frank Weinberg in 1903; figure 5 represents another joint of the same plant. Figure 196 represents a joint of a plant obtained by Professor Carlos de la Torre at Punta de los Molinos, Cuba, in 1912.

166. Opuntia cardiosperma Schumann, Monatsschr. Kakteenk. 9: 150. 1899.

About 2 meters high, erect, branching; joints narrowly oblong to obovate; rounded at apex, 10 to 15 cm. long or smaller in greenhouse specimens, easily breaking apart, pale green, more or less tuberculate; leaves minute, subulate; areoles large, 1 to 2 cm. apart, with white wool, when young having conspicuous secreting glands; spines, when present, 1 to 4, acicular, stiff, more commonly 1 or 2 from an areole, short, 1 to 2 cm. long, brownish at first but nearly white when old, porrect or ascending; glochids tardily developing, never conspicuous, brownish; flowers unknown; fruit elongated, pear-shaped, 7.5 cm. long; seeds 6 mm. broad, 2.5 to 3 mm. thick, cordate, gray, with broad yellow margins, woolly on the sides.

Type locality: At Recoleta, near Asunción, Paraguay.

Distribution: Paraguay.

Figure 197 represents joints of the plant sent to the New York Botanical Garden from La Mortola, Italy, in 1913.

167. Opuntia arechavaletai Spegazzini, Anal. Mus. Nac. Buenos Aires. III. 4: 520. 1905.

Plants tall, 1 to 3 meters high, much branched; joints flattened, oblong to obovate, 25 to 30 cm. long, green; spines, usually 1, sometimes 3, elongated, porrect, up to 9 cm. long, white, flattened; flowers 4.5 cm. long, yellow; stamens and style white; fruit violet-purple, 7 cm. long.

Type locality: Near Montevideo, Uruguay.

Distribution: Argentina and Uruguay.

Illustration: Anal. Mus. Nac. Montevideo 5: pl. 35.

168. Opuntia mieckleyi Schumann, Blühende Kakteen 1: pl. 44. 1903.

Plant erect, much branched; joints narrowly oblong, 15 to 25 cm. long, 4 to 6 cm. broad, glabrous, dark green, darker below the areoles; tubercles rather prominent; leaves small; areoles large, filled with white wool; spines, when present, 1 or 2, very short (5 mm. long), dark-colored; flower-buds obtuse; flowers brick-red, 6 cm. broad; petals irregularly notched; ovary spineless.

Type locality: In Paraguay.

Distribution: Paraguay; Estancia Loma, in San Salvador.

Named for W. Mieckley, gardener in the Berlin Botanical Garden.

Illustration: Blühende Kakteen 1: pl. 44.

169. Opuntia bonaerensis Spegazzini, Contr. Fl. Tandil 18. 1904.

Opuntia chakensis Spegazzini, Anal. Mus. Nac. III. 4: 519. 1905.

Two meters high, very much branched; joints spatulate to elliptic-spatulate, 15 to 25 cm. long, green; spines wanting or one, short; flowers orange, large, 4 cm. long; fruit obconic, 6 to 7 cm. long, dull purple; seeds 5 to 6 mm. long, subglobose.

Type locality: Sierra de Curamalal, Argentina.

Distribution: Argentina and perhaps Paraguay.

Opuntia paraguayensis Schumann (Monatsschr. Kakteenk. 9: 149. 1899) according to Spegazzini, and if so this name would supplant *O. bonaerensis.*

Illustration: Anal. Mus. Nac. Montevideo 5: pl. 23.

The three following, known to us only from descriptions, may belong to this series.

OPUNTIA STENARTHRA Schumann, Monatsschr. Kakteenk. 9: 149. 1899.

Shrubby, erect or decumbent, creeping over stones or ascending trees; joints thin, narrow, yellowish green, oblong to lanceolate, rounded at base, glabrous; spines either wanting or 1 to 3 from an areole, stoutish, subangular; flowers yellow; seeds woolly.

Type locality: Estancia Tagatiya, Paraguay.

Distribution: Paraguay.

OPUNTIA ASSUMPTIONIS Schumann, Monatsschr. Kakteenk. 9: 153. 1899.

Erect, 1 meter high; joints obovate, narrowed at base, thickish; spines at areoles on the faces of the joints none, but on the edges 1 or 2, stout, subulate, the upper one stouter, 3 to 4.5 cm. long; flower 3.5 cm. long, lemon-yellow; fruit pear-shaped, with a deep umbilicus; seeds densely villous.

Type locality: Asunción, Paraguay.

Distribution: Known only from the type locality.

OPUNTIA CANTERAI Arechavaleta, Anal. Mus. Nac. Montevideo 5: 278. 1905.

Stems erect, branching, 5 to 10 dm. high; joints elongated, shining green, attenuate below, 15 to 20 cm. long, 4 to 6 cm. broad; areoles orbicular, when young each surrounded by a violet spot, mostly spineless, about 4 cm. apart; spines, when present, 1 or 2 from an areole, 1.5 to 2 cm. long, whitish, with brownish tips; flowers orange-colored, 4 to 4.5 cm. broad; stigma-lobes 6 or 7, light flesh-colored; fruit somewhat pear-shaped, 5 cm. long; seeds flattened.

Type locality: In Uruguay.

Distribution: Along the coast of Uruguay.

In Uruguay this species flowers in January and February.

Series 14. SCHEERIANAE.

A single bushy species, with broad, thin, persistent joints, the areoles close together, each bearing several yellow, acicular spines and long white or yellow hairs. Its home is unknown.

170. Opuntia scheeri Weber, Dict. Hort. Bois 895. 1898.

About 1 meter high, branching at base, the lower branches sprawling over the ground; joints oblong to orbicular, 1.5 to 3 dm. long, bluish green; areoles circular, elevated, filled with short brown wool; spines 10 to 12, yellow, acicular, each surrounded by a row of long white or yellow hairs; flowers large, pale yellow, but in age salmon-colored; stigma-lobes deep green; fruit globular, red, juicy, truncate; seed small, 4 mm. broad, with a broad irregular margin.

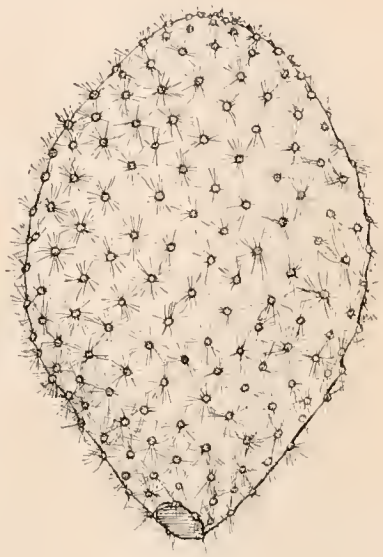


FIG. 198.—Opuntia scheeri. ×0.5.

Type locality: In Mexico.

Distribution: Mexico, but known to us only from cultivated specimens.

This is a very beautiful species, covered as it is by yellow spines and long hairs. A fine plant is growing in the open at La Mortola, Italy. The seedlings produce a long mass of soft white hairs almost covering the joints and giving an appearance very different from the adult plant. In this young stage, according to Mr. Alwin Berger, they readily pass for *Opuntia senilis* (*O. crinifera*).

Figure 198 represents a joint from a specimen sent from La Mortola, Italy, in 1912.

Series 15. DILLENIANAE.

Mostly bushy or tall species, with large, flat, persistent joints, and yellow spines which are sometimes brown at base, some species spineless or nearly so. We recognize thirteen species as composing the series, but many more have been described. The plants inhabit the southern United States, the West Indies, Mexico, and northern South America.

KEY TO SPECIES.

Spines nearly setaceous, most of them reflexed ..... 171. *O. chlorotica*
Spines, when present, acicular to subulate.
  Joints spineless, or with only 1 or 2 spines at some of the areoles, or spines very short.
    Corolla rotate; petals yellow.
      Plant tall; spines, when present, 2 cm. long or less ..... 172. *O. laevis*
      Plant depressed, bushy or spreading; spines, when present, up to 7 cm long .... 173. *O. stricta*
    Corolla cup-shaped; petals salmon ..... 173*a*. *O. keyensis*
  Joints usually manifestly spiny; spines mostly 2 or more at the areoles.
    Spines mostly stout, commonly flattened ..... 174. *O. dillenii*
    Spines acicular to subulate, terete, or slightly flattened at the base.

Joints elongated-lanceolate or oblong, several times longer than wide . . . . . 175. *O. linguiformis*
Joints obovate to suborbicular.
Spines long.
Areoles mostly 1.5 to 2 cm. apart.
Spines subulate, up to 7.5 cm. long . . . . . 176. *O. tapona*
Spines acicular, 4 cm. long or less.
Spines nearly clear yellow, short . . . . . 177. *O. littoralis*
Spines brown at base, long and slender . . . . . 178. *O. aciculata*
Areoles mostly 2.5 to 4 cm. apart.
Bushy species.
Spines yellow or yellowish brown . . . . . 179. *O. lindheimeri*
Spines pale yellow or whitish . . . . . 180. *O. cantabrigiensis*
Depressed or procumbent plant . . . . . 181. *O. procumbens*
Spines only 1.5 cm. long or less, or becoming longer on old joints.
Plant 1 meter high or less; joints thin . . . . . 182. *O. cañada*
Plant 3 to 5 meters high; joints very thick.
Spines reflexed; flowers yellow . . . . . 183. *O. pyriformis*
Spines spreading, deciduous; flowers orange-red . . . . . 183*a*. *O. bonplandii*

171. **Opuntia chlorotica** Engelmann and Bigelow, Proc. Amer. Acad. 3: 291. 1856.

Opuntia tidballii Bigelow, Pac. R. Rep. 4: 11. 1856.
Opuntia curvospina Griffiths, Bull. Torr. Club 43: 88. 1916.

Erect bushy, sometimes 2 meters high or more, with a definite trunk; main branches nearly erect; joints ovate to orbicular, sometimes broader than long, 15 to 20 cm. long, more or less glaucous, bluish green; leaves subulate, small, reddish at tip; areoles closely set, prominent; spines yellow, several, most of them usually appressed and reflexed, setaceous, 3 to 4 cm. long; glochids yellow, numerous, elongated, persistent; flowers yellow, 6 to 7.5 cm. broad; filaments white; fruit purple without, green within, 4 cm. long; seeds small.

FIG. 199.—Opuntia chlorotica.

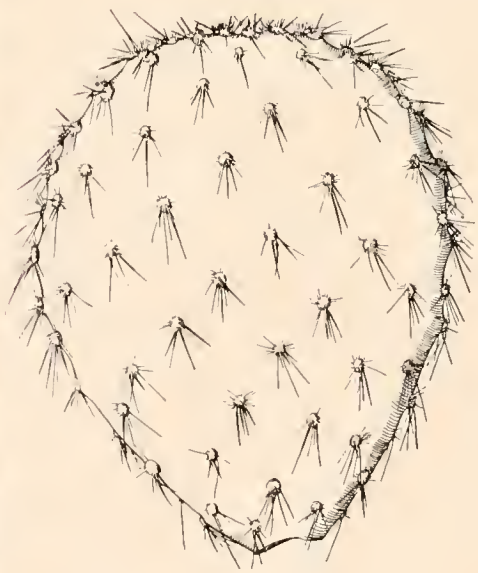


FIG. 200.—Opuntia chlorotica. ×0.4.

Type locality: On both sides of the Colorado from San Francisco Mountains to headwaters of Bill Williams River.

Distribution: Sonora and New Mexico to Nevada, California, and Lower California.

This species is of wide distribution, but is chiefly confined to mountain canyons, being rarely found on the open mesas.

Illustrations: Bull. Torr. Club 43: pl. 3; Pac. R. Rep. 4: pl. 6, f. 1 to 3; Bull. Torr. Club 43: pl. 2, this last as *Opuntia curvospina*.

1. Flowering joint of *Opuntia laevis*. 2. Flowering joint of *Opuntia dillenii*.
3. Upper part of flowering joint of *Opuntia aciculata*. (All natural size.)

Figure 199 is from a photograph of a plant with narrow joints, in McCleary's Canyon, Santa Rita Mountains, Arizona, taken by Dr. MacDougal; figure 200 represents a joint of a plant from the collection made by Professor J. W. Toumey at Tucson, Arizona, obtained by Dr. MacDougal in 1902.

OPUNTIA PALMERI Engelmann in Coulter, Contr. U. S. Nat. Herb. 3: 423. 1896.

This plant has not been again collected and is still a doubtful species; it came from St. George, southwestern Utah. In 1909 E. W. Nelson made a collection for us in this region, but the only shrubby, juicy-fruited species which he collected has brown spines and brown glochids, which would seem to exclude it from *O. palmeri*. It is not at all unlikely that *O. palmeri* should be referred to *O. chlorotica*, a widely dispersed species, but of which we have not seen any specimens from Utah.

172. **Opuntia laevis** Coulter, Contr. U. S. Nat. Herb. 3: 419. 1896.

Loosely few-branched, 1 to 2 meters high, but in cultivation often forming a low, dense bush; joints obovate to oblong, 1.5 to 3 dm. long, light green, often spineless but usually with a few (1 to 3) short spines 1 cm. long or less at the areoles of the upper part of the joint; areoles rather distant, small; flower large, 6 to 7 cm. broad; petals lemon-yellow, sometimes tinged with red, broad, and obtuse or retuse; filaments and style short, pale yellow; stigma-lobes green; ovary turbinate, more or less tuberculate, at first leafy, often bristly at top; fruit obovoid, 5 to 7 cm. long; seeds 4 to 5 mm. broad.

Type locality: In Arizona.

Distribution: In the mountains about Tucson, Arizona.

Referred by Professor Schumann to *O. inermis* (*O. stricta*), but it is not that species.

Illustrations: Ariz. Agr. Exp. Sta. Bull. 67: pl. 8, f. 1; N. Mex. Agr. Exp. Sta. Bull. 72: pl. 1; Plant World 11^{10}: f. 5.

Plate XXVIII, figure 1, represents a flowering joint of a plant brought by Dr. MacDougal from Tucson, Arizona, in 1902, to the New York Botanical Garden.

173. **Opuntia stricta** Haworth, Syn. Pl. Succ. 191. 1812.

Cactus opuntia inermis De Candolle, Pl. Succ. Hist. 2: pl. 138 [C]. 1799.*
Cactus strictus Haworth, Misc. Nat. 188. 1803.
Opuntia inermis De Candolle, Prodr. 3: 473. 1828.
Opuntia airampo Philippi, Anal. Univ. Chile 85: 492. 1894.
Opuntia parva Berger, Hort. Mortol. 411. 1912.
Opuntia bentonii Griffiths, Rep. Mo. Bot. Gard. 22: 25. 1912.
Opuntia longiclada Griffiths, Bull. Torr. Club 43: 525. 1916 (according to description and illustration).

Bushy, low, spreading plants, sometimes forming large clumps, seldom over 8 dm. high; joints obovate to oblong, usually 8 to 15 cm. long, but sometimes much elongated and then 30 cm. long or more, green or bluish green, glabrous, often spineless especially in greenhouse specimens, sometimes but a spine or two on a joint, at other times spines more abundant; leaves stout, subulate, 3 to 4 mm. long; areoles distant, the wool brownish, the glochids short; spines, when present, usually 1 or 2 from an areole, stiff, terete, yellow, 1 to 4 cm. long; flowers 6 to 7 cm. long; petals yellow, broad, obtuse, apiculate; filaments yellow to greenish; style usually white; stigma-lobes usually white but sometimes greenish; fruit purple, usually broadest at top, tapering to a slender base, 4 to 6 cm. long, with a more or less depressed umbilicus.

Type locality: Not given.

Distribution: Western Cuba; Florida to southern Texas.

Opuntia vulgaris balearica Weber (Dict. Hort. Bois 894. 1898) is given by Weber as a synonym of *O. inermis; Opuntia balearica* Weber (Hirscht, Monatsschr. Kakteenk. 8: 175. 1898) has also been used, but not described, and Hirscht says it belongs here.

This species is often cultivated on the west coast of South America. It was there given the name *O. airampo* by Dr. Philippi, who supposed it to be the airampo of the Peruvians, a native species, quite different from this one.

This species is the pest pear of New South Wales and Queensland. It has now run wild over thousands of acres of the best agricultural and grazing land of the interior of

*Berger (Hort. Mortol. 411. 1912) gives the date 1797.

Australia. J. H. Maiden says: "The growth of this *Opuntia* is one of the wonders of the world, and the spread of few plants in any country can be compared with it."

Illustrations: Dept. Agr. N. S. W. Misc. Publ. 253: pl. [5]; Gard. Chron. III. 34: f. 32; Gartenflora 31: pl. 1082, f. d, e, f; De Candolle, Pl. Succ. Hist. 2: pl. 138 [C]; De Tussac, Fl. Antill. 2: pl. 34, the last two as *Cactus opuntia inermis;* Agr. Gaz. N. S. W. 23: pl. opp. 713; pl. opp. 714; pl. opp. 716; Blühende Kakteen 2: pl. 108, all these as *Opuntia inermis.*

Plate XXVII, figure 4, represents a flowering joint of the plant collected by Dr. Britton and John F. Cowell on limestone rocks near Pinar del Río, Cuba, in 1911.

173*a*. **Opuntia keyensis** Britton. (See Appendix, p. 222.)

174. **Opuntia dillenii** (Ker-Gawler) Haworth, Suppl. Pl. Succ. 79. 1819.

Cactus dillenii Ker-Gawler, Edwards's Bot. Reg. 3: pl. 255. 1818.
Opuntia horrida Salm-Dyck in De Candolle, Prodr. 3: 472. 1828.
Opuntia maritima Rafinesque, Atl. Journ. 146. 1832.
Opuntia tunoidea Gibbes, Proc. Elliott Soc. Nat. Hist. 1: 272. 1859

FIG. 201.—Opuntia dillenii, Antigua, West Indies.

Low, spreading bushes growing in broad clumps and often forming dense thickets, or tall and much branched, 2 to 3 meters high, sometimes with definite terete trunks; joints obovate to oblong, 7 to 40 cm. long, the margin more or less undulate, bluish green, somewhat glaucous, but bright green when young, the areoles somewhat elevated; leaves subulate, curved backward, 5 mm. long; areoles often large, filled with short brown or white wool when young, usually few and remote, on old joints 10 to 12 mm. in diameter; spines often 10 from an areole on first-year joints, very variable, usually more or less flattened and curved, sometimes terete and straight, yellow, more or less brown-banded, or mottled, often brownish in age, sometimes 7 cm. long, but usually shorter, sometimes few or none; glochids numerous, yellow; wool in areoles short, sometimes brown, sometimes white; flowers in the typical form lemon-yellow, in some forms red from the first, 7 to 8 cm. long; petals broadly obovate, 4 to 5 cm. long; filaments greenish yellow; style thick, white; stigma-lobes white; fruit pear-shaped to subglobose, narrowed at base, 5 to 7.5 cm. long, purplish, spineless, juicy.

Type locality: Based on Dillenius's illustration.

Distribution: Coasts of South Carolina, Florida, Bermuda, the West Indies, east coast of Mexico, and northern South America; extending inland in Cuba.

1

2

1. View of *Opuntia keyensis*.
2. View of *Opuntia dillenii*.

This species is composed of many races varying greatly in habit, character and number of spines, shape of joints, and color of flowers. Brother León has sent us specimens of several individually quite different plants which inhabit hilltops in Cuba.

Opuntia lucayana Britton (Bull. N. Y. Bot. Gard. 4: 141. 1906), inhabiting Grand Turk Island, Bahamas, differs in having elongated, often narrowly oblong joints 2 to 4 times as long as wide and many elongated, little-flattened spines. It grows with *Opuntia dillenii* and *O. nashii*, and is believed to be a hybrid with these species as parents. A closely similar plant was observed on Buck Island, St. Thomas, Danish West Indies, growing immediately with *O. dillenii* and *O. rubescens*, the hybrid nature of which was unmistakable, and similar plants were seen also on Antigua, British West Indies.

Opuntia cubensis Britton and Rose (Torreya 12: 14. 1912), observed in a valley near the southern coast of Cuba at Guantánamo Bay, differs in having narrower joints, rather readily separable and smaller flowers, its stout spines little flattened. It grows near colonies of *Opuntia dillenii* and *O. militaris*, and is probably a hybrid between them.

Reference has already been made to the possible hybrid origin of *Opuntia antillana*, with *O. dillenii* as one of its parents. (See p. 115).

Two varieties of *Opuntia dillenii* are given by name only; *minor* Salm-Dyck (Hort. Dyck. 185. 1834); *orbiculata* Salm-Dyck (Cact. Hort. Dyck. 1849. 67. 1850).

Opuntia gilva Berger (Hort. Mortol. 233. 1912) is unpublished. The name was applied to a specimen collected by Carl F. Baker in Cuba in 1907, and has been distributed under this name. It is only a form of this very variable species.

The plant is hardy on the Gulf coast of the United States and in southern California. It is widely distributed through cultivation in the warmer parts of the Old World, being a "pest pear" in southern India and in Australia; it is used for hedges in Teneriffe, and is common along the sea on Grand Canary Island. On Bermuda, when growing in shade, the plant is often spineless, and its joints elongate sometimes to a length of 3 dm., while only 6 or 7 cm. wide. This elongation of the joints also appears in plants from Florida.

Illustrations: Edwards's Bot. Reg. 3: pl. 255, as *Cactus dillenii;* Rep. Mo. Bot. Gard. 22: pl. 1, 2, both these as *Opuntia bentonii;* Dillenius, Hort. Elth. 2: pl. 296, this as *Tuna major*, etc.; Amer. Journ. Pharm. 68: pl. opp. 169, as *Opuntia vulgaris*; Descourtilz, Fl. Med. Antill. 7: pl. 513, this as *Cactus opuntia*. Abh. Bayer. Akad. Wiss. München 2: pl. 3, f. 7 (?); Amer. Garden 11: 473 (?); Cycl. Amer. Hort. Bailey 3: f. 1545, 1546; Cact. Journ. 1: 154 (?); Dept. Agr. N. S. W. Misc. Publ. 253: pl. [2]; Dict. Gard. Nicholson 2: f. 757; W. Watson, Cact. Cult. f. 86, all these as *Opuntia tuna;* Journ. N. Y. Bot. Gard. 10: f. 26, this as *Opuntia inermis;* Loudon, Encycl. Pl. ed. 3. f. 6878, this as *Cactus tuna;* Britton, Fl. Bermuda 255.

Plate XXVIII, figure 2, represents a flowering joint of a plant collected in 1901 by N. L. Britton and J. F. Cowell on the Island St. Martin, West Indies; plate XXIX, figure 1, is from a photograph of the related *Opuntia keyensis* growing on Boot Key, Florida, taken by Marshall A. Howe in 1909; figure 2 is from a photograph of the plant on Bermuda, obtained by Dr. Britton in 1912. Figure 201 is from a photograph of the plant growing on Antigua, British West Indies, taken by Paul G. Russell in 1913.

175. Opuntia linguiformis Griffiths, Rep. Mo. Bot. Gard. 19: 270. 1908.

A bushy plant, 1 meter high or more; joints elongated, oblong to ovate-oblong or lanceolate, 2 to 5 dm. long or even more, often several times longer than wide, pale green and slightly glaucous; leaves 6 mm. long, terete; spines yellow, very slender, terete or nearly so; areoles filled with brown wool; flowers yellow, 7 to 8 cm. broad; petals broad; filaments white or greenish at base; stigma-lobes 9, green; ovary bearing numerous long glochids at the upper areoles; fruit reddish purple; seeds 3 or 4 mm. broad, acute on the back.

Type locality: Near San Antonio, Texas.
Distribution: Southern Texas, in the vicinity of San Antonio.

This plant is rather common in cultivation in the Southwest and is now found in most cactus collections. According to Dr. Griffiths, it is occasionally found wild near San Antonio. We have seen somewhat similar plants from near Brownsville, Texas, probably referable to one of the races of *Opuntia lindheimeri*.

On account of the shape of the joints, this species is commonly called cow's tongue or lengua de vaca.

Illustration: Rep. Mo. Bot. Gard. 19: pl. 27, lower figure.

Plate xxx represents a flowering joint of a plant obtained by Dr. MacDougal from the collection of Professor J. W. Toumey at Tucson, Arizona, for the New York Botanical Garden in 1902.

176. **Opuntia tapona** Engelmann in Coulter, Contr. U. S. Nat. Herb. 3: 423. 1896.

Low, spreading plants rarely over 6 dm. high; joints glabrous, orbicular to obovate, 20 to 25 cm in diameter, turgid, pale green; spines 2 to 4, yellow, one much longer, 5 to 7 cm. long, slender, porrect or sometimes curved downward; glochids brownish; fruit 4 to 6 cm. long, clavate, dark purple without, red within, spineless.

Type locality: Near Loreto, Lower California.

Distribution: Southern part of Lower California.

Figure 202 represents a joint of the plant collected by Dr. Rose on Pichilinque Island, Lower California, in 1911.

Related to *O. tapona*, but probably specifically distinct from it, is a plant growing in the mountains of Cedros Island, Lower California; it was recorded from this island by Dr. E. L. Greene as *O. engelmannii*, and a specimen was brought to Washington by Dr. Rose in 1911. This plant may be described as follows: About 1 meter high; joints oblong, large, 20 cm. long or more, smooth; areoles 3 cm. apart or more, very large, filled with brown wool; spines usually about 7, pale yellow, slender, terete, the longest ones 3 cm. long; glochids yellow. (Rose No. 16170.)

Fig. 202.—Opuntia tapona. ×0.4.

Fig. 203.—Opuntia littoralis.

M. E. Eaton del.

Flowering joint of *Opuntia linguiformis*.
(Natural size.)

177. **Opuntia littoralis** (Engelmann) Cockerell, Bull. South. Calif. Acad. 4: 15. 1905.

Opuntia engelmannii littoralis Engelmann in Brewer and Watson, Bot. Calif. 1: 248. 1876.
Opuntia lindheimeri littoralis Coulter, Contr. U. S. Nat. Herb. 3: 422. 1896.

Bushy plants, low and spreading; joints thick, orbicular to oblong, 15 cm. long or more, usually smaller in greenhouse plants, dull green; areoles rather closely set, large, often elevated on old joints; spines numerous, yellow, rather short on young joints (1 to 2 cm. long), but on old joints much longer, in age more or less flattened; wool of the areoles brown; flowers large, yellow, 8 to 12 cm. broad; sepals broad, apiculate; petals retuse; ovary with many areoles; fruit red, juicy; seeds 4 to 5 mm. in diameter.

Type locality: Coast from Santa Barbara to San Diego, California.

Distribution: Along and near the coast of southern California.

This species was very briefly described as a variety of *Opuntia engelmannii* in 1876. No definite locality was given for it, and the original material preserved is so poor that its identification is doubtful. We have taken as our representative of this species the low, bushy plant with rather thick joints, large and closely set areoles and yellow spines.

Opuntia littoralis often grows in proximity to *O. occidentalis* in southern California, and hybrids of the two may exist.

Figure 203 represents joints of the plant collected at Elsinore, California, by Dr. MacDougal in 1913.

178. **Opuntia aciculata** Griffiths, Proc. Biol. Soc. Washington 29: 10. 1916.

Low, bushy plant, 1 meter high or more, often 3 meters broad or more, the lower branches decumbent and sending up erect branches; joints obovate, 12 to 20 cm. long, rounded at apex, dull dark green, somewhat glaucous, bearing large, closely set areoles, these often spineless; leaves subulate, 7 mm. long; spines several in a cluster, acicular, slender, 3 to 5.5 cm. long, often reflexed, brownish at base, with yellow tips, seemingly deciduous; glochids numerous, from all parts of the areoles, long, persisting for several years; flower golden yellow, sometimes with a greenish center, large, 8 to 10 cm. broad; petals broad, rounded or retuse; filaments yellowish; style dull yellowish green; stigma-lobes 8 to 10, green; fruit pyriform, purple.

Type locality: Near Laredo, Texas.

Distribution: On high gravelly ground at type locality and vicinity.

This species is not very common about Laredo, Texas, but grows in small colonies usually to the exclusion of all other plants. It can easily be distinguished from related species, and is usually restricted to dry hills. Our description is based on specimens obtained by Dr. Rose at Laredo in 1913. Since then it has been grown both in Washington and New York.

Plate XXVIII, figure 3, represents a flowering joint of the plant collected by Dr. Rose near the type locality in 1913.

179. **Opuntia lindheimeri** Engelmann, Bost. Journ. Nat. Hist. 6: 207. 1850.

Opuntia dulcis Engelmann, Proc. Amer. Acad. 3: 291. 1856.
Opuntia lindheimeri dulcis Coulter, Contr. U. S. Nat. Herb. 3: 421. 1896.
Opuntia engelmannii dulcis Schumann, Gesamtb. Kakteen 725. 1898.
Opuntia cacanapa Griffiths and Hare, N. Mex. Agr. Exp. Sta. Bull. 60: 47. 1906.
Opuntia ferruginispina Griffiths, Rep. Mo. Bot. Gard. 19: 267. 1908.
Opuntia tricolor Griffiths, Rep. Mo. Bot. Gard. 20: 85. 1909.
Opuntia texana Griffiths, Rep. Mo. Bot. Gard. 20: 92. 1909.
Opuntia subarmata Griffiths, Rep. Mo. Bot. Gard. 20: 94. 1909.
Opuntia alta Griffiths, Rep. Mo. Bot. Gard. 21: 165. 1910.
Opuntia gomei Griffiths, Rep. Mo. Bot. Gard. 21: 167. 1910.
Opuntia sinclairii Griffiths, Rep. Mo. Bot. Gard. 21: 173. 1910.
Opuntia cyanella Griffiths, Rep. Mo. Bot. Gard. 22: 30. 1912.
Opuntia gilvoalba Griffiths, Rep. Mo. Bot. Gard. 22: 35. 1912.
Opuntia convexa Mackensen, Bull. Torr. Club 39: 290. 1912.
Opuntia griffithsiana Mackensen, Bull. Torr. Club 39: 291. 1912.
Opuntia reflexa Mackensen, Bull. Torr. Club 39: 292. 1912.
Opuntia deltica Griffiths, Bull. Torr. Club 43: 84. 1916.
Opuntia laxiflora Griffiths, Bull. Torr. Club 43: 85. 1916.
Opuntia flexospina Griffiths, Bull. Torr. Club 43: 87. 1916.
Opuntia squarrosa Griffiths, Bull. Torr. Club 43: 91. 1916.

Usually erect, 2 to 4 meters high, with a more or less definite trunk, but at times much lower and spreading; joints green or bluish green, somewhat glaucous, orbicular to obovate, up to 25 dm. long; leaves subulate, 3 to 4 mm. long, somewhat flattened, pointed; areoles distant, often 6 cm. apart; spines usually 1 to 6, often only 2, one porrect and 4 cm. long or more, the others somewhat shorter and only slightly spreading, pale yellow to nearly white, sometimes brownish or blackish at base, or some plants spineless; glochids yellow or sometimes brownish, usually prominent; petals yellow to dark red; stigma-lobes usually green; fruit purple, pyriform to oblong, 3.5 to 5.5 cm. long.

Type locality: About New Braunfels, Texas.

Distribution: Southwestern Louisiana, southeastern Texas, and Tamaulipas, Mexico.

Opuntia lindheimeri is an extremely variable species, composed of many races, differing in armament, color of flowers, size and shape of joints and of fruit. Certain forms have been described which in cultivation we have been able to recognize as possibly distinct; but in the field they seem to intergrade with other forms, indicating that they are at most only races of a very variable species. In the delta of the Rio Grande this is especially true, and from this region a number of species has been described. In fact, all the plants described as species which are cited above in the synonymy grow within a relatively small distributional area. Dr. Rose has examined all this region and is of the opinion that only one species of this series exists there, and this we believe is to be referred to *Opuntia lindheimeri*. It is very common about Brownsville and Corpus Christi, where it forms thickets covering thousands of acres of land. It is very variable in habit, being either low and widely spreading or becoming tall and tree-like, sometimes 3 meters high, with a definite cylindric trunk. Plants from these two extremes, if studied apart from the field, might be considered as different species, but in the field one sees innumerable intergrading forms. The low, prostrate forms gradually pass into others with more or less erect or ascending branches, while the large tree-like forms often bear large lateral branches which lie prostrate on the ground, indicating that they have developed from the prostrate ones. Decided differences in the flower colors have been pointed out in the original descriptions, and we have observed them in greenhouse specimens, but they do not correlate with other characters.

Opuntia ellisiana Griffiths (Rep. Mo. Bot. Gard. 21: 170. pl. 25. 1910), an unarmed species, is known only from cultivated plants. Dr. Griffiths states that it is quite different from the *Ficus-indicae* series, which it much resembles, and is quite hardy in southern Texas. It may be a spineless race of the common *O. lindheimeri* of this region.

Opuntia pyrocarpa Griffiths (Bull. Torr. Club 43: 90. 1916) we do not know; in its long pyriform fruit it suggests this plant; the type comes from Marble Falls, Texas.

O. winteriana Berger and *O. haematocarpa* Berger (Bot. Jahrb. Engler 36: 455 and 456. 1905) are of this relationship, but have browner spines than is usual in the species.

Opuntia leptocarpa Mackensen (Bull. Torr. Club 38: 141. 1911), characterized by its low, bushy habit and elongated, almost abnormal fruits, suggests a natural hybrid between *O. lindheimeri* and *O. macrorhiza*. Indeed, Mr. Mackensen described the species as intermediate between these two, and all three species are often found growing together. *O. leptocarpa* originally came from San Antonio, Texas.

Illustrations: Ann. Rep. Smiths. Inst. 1911: pl. 3, 4, B; Cact. Mex. Bound. pl. 75, f. 5 to 7; Karsten, Deutsch. Fl. f. 501. 13, 13^a, 13^b; N. Mex. Agr. Exp. Sta. Bull. 78: pl. [13, 14], all as *Opuntia dulcis*. Bull. U. S. Dept. Agr. 31: pl. 3, f. 1, this as *Opuntia cacanapa;* Rep. Mo. Bot. Gard. 20: pl. 4, in part, this as *Opuntia tricolor;* Rep. Mo. Bot. Gard. 20: pl. 9; pl. 13, f. 1, these two as *Opuntia texana*. Bull. U. S. Dept. Agr. 31: pl. 2, f. 1; Rep. Mo. Bot. Gard. 20: pl. 2, f. 1; pl. 11; pl. 13, f. 4, all these as *Opuntia subarmata*. Rep. Mo. Bot. Gard. 21: pl. 19; pl. 20, in part, these two as *Opuntia alta*. Rep. Mo. Bot. Gard. 21: pl. 21; pl. 22, in part, these two as *Opuntia gomei*. Rep. Mo. Bot. Gard. 21: pl. 28, this as *Opuntia sinclairii*. Rep. Mo. Bot. Gard. 22: pl. 9, in part; pl. 10; Journ. Agr. Research 4. pl. f., these three as *Opuntia cyanella*. Rep. Mo. Bot. Gard. 22: pl. 9, in part; pl. 16, 17, these three as *Opuntia gilvoalba*. Bull. U. S. Dept. Agr. 31: f. 1.

M. E. Eaton del.

Flowering joints of *Opuntia lindheimeri*.

1. Orange-flowered race. 2. Red-flowered race.
(Natural size.)

Plate XXXI, figure 1, represents a flowering joint of a plant collected near Brownsville, Texas, by Dr. Rose in 1913; figure 2 represents a flowering joint of a plant obtained by the same collector at the same locality; plate XXXII, figure 1, represents a flowering joint of a plant sent by Mr. M. Mackensen from the type locality of *O. leptocarpa* in 1910; figure 2 shows the fruit of the same.

180. Opuntia cantabrigiensis Lynch, Gard. Chron. III. **33**: 98. 1903.

Opuntia engelmannii cuija Griffiths and Hare, N. Mex. Agr. Exp. Sta. Bull. **60**: 44. 1906.
Opuntia cuija Britton and Rose, Smiths. Misc. Coll. **50**: 529. 1908.

Rounded bushy plant, 1 to 2 meters high; joints orbicular to obovate, 12 to 20 cm. long, rather pale bluish green; areoles remote, large, filled with brown wool; spines usually 3 to 6 but sometimes more, somewhat spreading, acicular, yellow with brown or reddish bases, 1.5 to 4 cm. long; glochids numerous, large, 1 cm. long or more, yellowish, not forming a brush; flowers 5 to 6 cm. long, yellowish with reddish centers; upper areoles on the ovary bearing long bristles; stigma-lobes green; fruit, globular, about 4 cm. in diameter, purple; seeds numerous, small, 4 mm. in diamter.

Type locality: Described from specimen in Cambridge Botanic Garden, England.

Distribution: Very common in the States of San Luis Potosí, Querétaro, and Hidalgo, Mexico.

Opuntia chrysacantha (Berger, Hort. Mortol. 231. 1912, name only), an undescribed species, probably belongs here.

Our determination of the identity of *O. cantabrigiensis* and *O. cuija* is based on a living plant of the former received from Mr. Lynch.

Illustrations: N. Mex. Agr. Exp. Sta. Bull. **60**: pl. 2, as *Opuntia engelmannii cuija;* Gard. Chron. III. **30**: f. 123, as *Opuntia engelmannii.*

Figure 204 represents joints of a plant collected by Dr. Rose near Ixmiquilpan, Hidalgo, Mexico, in 1905.

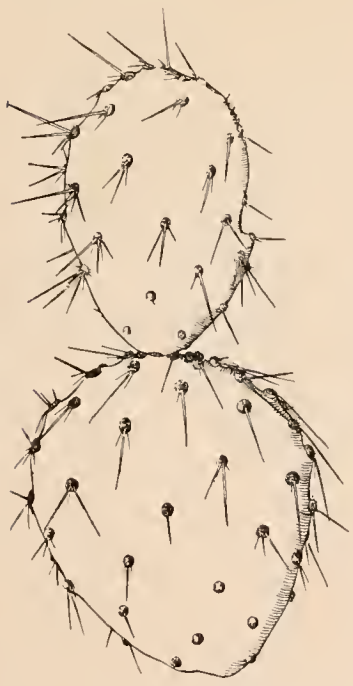


FIG. 204.—O. cantabrigiensis. ×0.4.

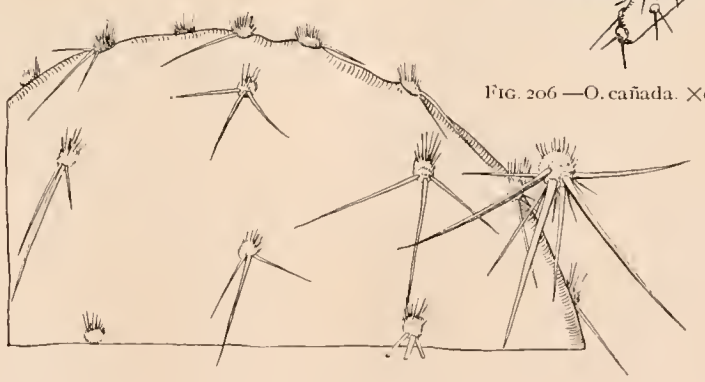


FIG. 205.—O. procumbens. ×0.5.

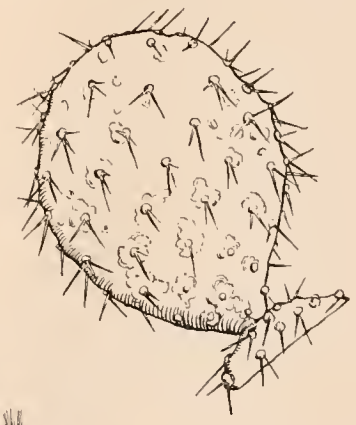


FIG. 206.—O. cañada. ×0.75.

181. Opuntia procumbens Engelmann, Proc. Amer. Acad. **3**: 292. 1856.

Stems low and spreading, forming broad masses; joints "always edgewise," orbicular, 2 to 4 or even 5 dm. in diameter, yellowish green, somewhat glaucous; areoles distant (3 to 5 cm. apart),

large, bearing long yellow glochids; spines 1 to 5, spreading, 2.5 to 5 cm. long, yellow, lighter above, flattened; flowers said to be yellow; fruit red, juicy.

Type locality: San Francisco Mountains to Cactus Pass, Arizona.

Distribution: Northern Arizona.

This species has long been wanting or poorly represented in our great herbaria. Dr. Rose collected it near Flagstaff, Arizona, and the above description is largely drawn from his notes; but his material was lost. In 1913 it was again collected by Mr. E. A. Goldman.

Illustration: Pac. R. Rep. 4: pl. 6, f. 4, 5.

Figure 205 is copied from the illustration above cited.

182. Opuntia cañada Griffiths, Rep. Mo. Bot. Gard. 20: 90. 1909.

Plant about 1 meter high, with many erect or ascending branches, forming a broad top; joints ovate to obovate, 16 to 22 cm. long, smooth, and shining; leaves subulate, 1 cm. long; spines various, white to yellow, flattened, sometimes twisted; glochids few on young joints, very abundant on old ones; flowers yellow with red or orange centers; style white to reddish; stigma-lobes green; fruit red.

Type locality: Foothills of the Santa Rita Mountains, Arizona.

Distribution: Southeastern Arizona.

Dr. Griffiths comments on the close relationship of this plant to *O. laevis*.

Illustrations: Rep. Mo. Bot. Gard. 20: pl. 2, f. 6; pl. 6, in part; pl. 13, f. 2, 12.

Figure 206 is copied from the second illustration above cited.

183. Opuntia pyriformis Rose, Contr. U. S. Nat. Herb. 12: 292. 1909.

Plant 3 to 5 meters high, with widely spreading branches, the lower ones almost resting on the ground and 3 to 5 meters long; joints obovate, thick, 18 cm. long or more; areoles closely set, small; spines 1 or 2, on old joints more, usually reflexed, slender, weak, yellow, 10 to 22 mm. long; flowers yellow; fruit 4 cm. long, somewhat tuberculate, spineless, its large areoles crowded with brown hairs forming hemispherical cushions.

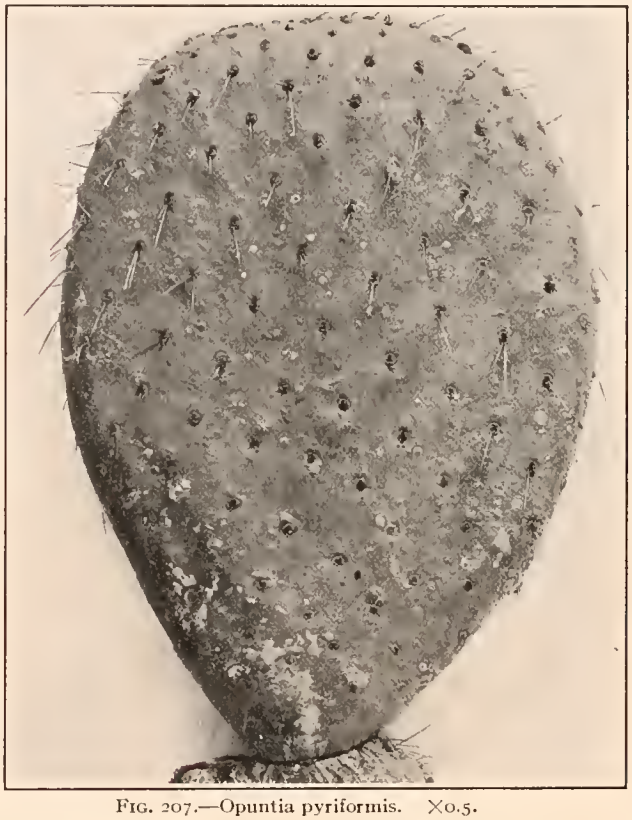


FIG. 207.—Opuntia pyriformis. ×0.5.

Type locality: Hacienda de Cedros, Zacatecas, Mexico.

Distribution: Zacatecas, Mexico.

The type of this species is in the U. S. National Herbarium. It is known only from the original collection of Professor F. E. Lloyd, made in 1908.

Illustrations: Contr. U. S. Nat. Herb. 12: f. 35; pl. 26.

Figure 207 is copied from the second illustration above cited.

183 *a*. Opuntia bonplandii (HBK.) Weber. (See Appendix, p. 223.)

The three following described species may belong to this series:

OPUNTIA BECKERIANA Schumann, Gesamtb. Kakteen 722. 1898.

The plant on which this species is based was sent to Dr. Schumann from a garden at Bordighera, Italy, and its origin is unknown; Dr. Schumann thought that it might have

come from Mexico. From the description it may belong to our series *Dillenianae*, but we are unable to associate it with any species known to us; the ovary is described as compressed and tubercled.

OPUNTIA ANAHUACENSIS Griffiths, Bull. Torr. Club **43**: 92. 1916.

A low, reclining or prostrate plant, up to 5 dm. high, 1.5 meters broad; joints obovate, glossy, yellowish green, 27 cm. long, 13 cm. broad; spines yellow or becoming white, 1 or 2, porrect, flattened, twisted, 2 or 3 cm. long; flowers yellow; style white; stigma-lobes 6, white; fruit dark purplish red, pyriform, 7 cm. long.

Type locality: Anahuac, Texas.

Distribution: Known only from the type locality, at the mouth of Trinity River, eastern Texas.

OPUNTIA MEGALANTHA Griffiths, Bull. Torr. Club **43**: 530. 1916.

A tall, erect, open-branching plant, 2 meters high or more; joints obovate, glaucous, grayish green, 21 cm. long, 14 cm. broad; spines yellow, 1 to 3, or even 5 or 6 on old wood, the longest often 4 to 5 cm. long; flowers yellow, 10 to 11 cm. in diameter; petals 5 cm. long, obovate; style white; stigma-lobes 8 or 9, white or tinged with green; fruit dark red.

Known only from cultivated plants received from the Berlin Botanical Garden, where it was grown as *Opuntia bergeriana*.

Series 16. MACDOUGALIANAE.

Erect, mostly tall species, with flat, broad, and thin, persistent joints, the epidermis, at least that of the ovary, pubescent or puberulent. The spines, when present, yellow. There are about half a dozen species, natives of central and southern Mexico.

KEY TO SPECIES.

Joints merely finely puberulent or glabrous; spines 1.5 cm. long or less; ovary velvety ..... 184. *O. durangensis*
Joints distinctly pubescent; spines 2 to 3 cm. long.
  Petals red.
    Style shorter than the petals 185. *O. atropes*
    Style as long as the petals. 186. *O. affinis*
  Petals yellow.
    Spines acicular, at first yellow, soon white..... 187. *O. macdougaliana*
    Spines subulate.
      Petals retuse; areoles of ovary many, approximate..... 188. *O. velutina*
      Petals mucronate; areoles of ovary few, distant..... 189. *O. wilcoxii*

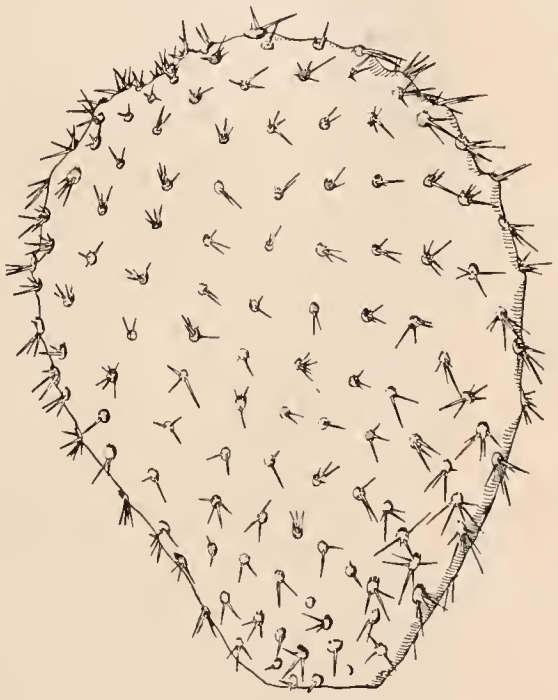


FIG. 208.—Opuntia durangensis. ×0.4.

184. Opuntia durangensis Britton and Rose, Smiths. Misc. Coll. **50**: 518. 1908.

Joints broadly obovate, about 20 cm. long, 16 cm. broad, pale green, glabrous or minutely puberulent, bearing numerous areoles; areoles 1 to 2 cm. apart, elevated; spines 3 to 5 at an areole, short, 1.5 cm. long or less, pungent, spreading, yellow, but in age becoming darker; glochids brown, 2 to 3 mm. long; flowers yellow, 5 cm. long; petals broad, apiculate; ovary 3 to 4 cm. long, finely pubescent, bearing many areoles with numerous glochids and a few spines; fruit white or red; seeds about 3 mm. broad.

Type locality: Near Durango, Mexico.

Distribution: Central Mexico.

This species was collected by the late Dr. E. Palmer in 1912, but he did not record the size and habit of the plant. The joints suggest a large, bushy species.

Figure 208 represents a joint of the type specimen.

185. Opuntia atropes Rose, Smiths. Misc. Coll. **50**: 518. 1908.

Plant 1 to 3 meters high, much branched; joints oblong to obovate, 20 to 30 cm. long, deep green, softly pubescent; young joints somewhat glossy, leaves 4 to 5 mm. long, acuminate, pubescent, standing almost at right angles to the joints, the tips reddish, areoles circular, filled with short tawny wool; young spines white or yellowish; old spines 3 to 6 cm. long, somewhat angled, standing almost at right angles to the joints, dark yellow or brown at the base, much lighter, often white above; glochids numerous, long, yellow; petals reddish; ovary pubescent, covered with large cushion-like areoles bearing long glochids near the top but with few spines or none, truncate at apex.

Type locality: Lava beds near Yautepec, Morelos, Mexico.
Distribution: Central Mexico.

186. Opuntia affinis Griffiths, Proc. Biol. Soc. Washington **27**: 27. 1914.

"A low, arborescent species, from 125 cm. high with us at 4 years of age to 2 m. or more in its natural habitat; joints obovate, 13 by 35 cm., broadly rounded above and gradually narrowed below, densely silky, villous to the touch, and villous nature plainly visible when viewed in proper light, slightly raised at areoles, the tubercles being surrounded by a sunken dark-green line; leaves small, subulate, pointed, scarcely 2 mm. in length; areole small, obovate, 3 mm. long, 25 to 30 mm. apart, white to gray; spicules light straw-colored, at first not conspicuous but rather in a connivent tuft, 3 mm. long; spines absent below and 1 to 5 in upper five-sixths of joint, straw-colored, becoming white the second year, the longest 3 cm. and others much shorter, increasing in age in both length

FIG. 209.—Opuntia macdougaliana, Tehuacán, Mexico.

and numbers, at 3 years often 10 in number and some 6 cm. long, divergent, flattened, angular, twisted; flowers dull dark-red in bud, with stigma protruding the day before the petals spread, small, about 3 cm. in diameter when opened, petals 20 to 25 mm. long, slightly, when at all, recurved, ribs of petals red and wings orange, filaments greenish below and pink above, style bright-glossy red, stigma dull greenish red, 4-parted, equaling the petals in length; ovary small, subglobose, deeply pitted, 15 to 17 mm. in diameter, with small subcircular to slightly transversely elongated, dirty brown areoles, 4 mm. apart; fruit small, subglobose, red."

Type locality: State of Oaxaca, Mexico.

Distribution: Known only from type locality.

Our examination of the type specimen of this species showed that it is closely related to *Opuntia macdougaliana*, differing in the color of its petals, which may not be a specific character.

FIG. 210.—Opuntia macdougaliana

187. **Opuntia macdougaliana** Rose, Smiths. Misc. Coll. 50: 516. 1908.

Opuntia micrarthra Griffiths, Monatsschr. Kakteenk. 23: 130. 1913.

Plant about 4 meters high, with a distinct cylindric trunk branching from near the base; joints oblong, 30 cm. long by 8 to 10 cm. broad, softly pubescent; areoles distinct, small; spines generally 4, one much longer (2.5 to 4 cm. long), somewhat flattened, yellowish, becoming whitish in age; glochids short, numerous, yellow; fruit globular to oblong, 5 cm. long, the surface divided into diamond-shaped plates, red, with a broad deep cup at apex, the numerous small rounded areoles filled with clumps of yellow glochids, very rarely with one or two spines.

Type locality: Near Tehuacán, Mexico.

Distribution: Southern Mexico.

Figure 209 is from a photograph of the type plant taken by Dr. MacDougal at El Riego, Tehuacán, Mexico, in 1906; figure 210 represents a plant grown from a cutting of the type.

188. Opuntia velutina Weber in Gosselin, Bull. Mus. Hist. Nat. Paris 10: 389. 1904.

Opuntia nelsonii Rose, Smiths. Misc. Coll. 50: 516. 1908.

Stems 1 to 4 meters high; joints flattened, oblong to pear-shaped in outline, 15 to 20 cm. long by 10 to 15 cm. broad near the top, pubescent, pale yellowish green in herbarium specimens; areoles 2 to 3 cm. apart; spines 2 to 6, yellow, becoming white in age, very unequal, the longer ones 3 to 4 cm. long; bristles many, yellow, becoming brownish; flowers rather small; petals yellow, 1 to 3 cm. long; ovary pubescent, bearing many yellowish brown bristles; filaments red; stigma-lobes pale green; fruit "dark red."

Type locality: In Guerrero, Mexico.

Distribution: Southern Mexico.

Plate XXXII, figure 3, represents a flowering joint of a plant collected at Tehuacán, Mexico, by Dr. MacDougal and Dr. Rose in 1906.

189. Opuntia wilcoxii sp. nov.

A tall, bushy plant, 1 to 2 meters high, very much branched; joints oblong, thinnish, large, 2 cm. long, dark green, more or less purplish about the large areoles, finely puberulent; glochids numerous, long, yellow; spines 1 to 3, one very long (5 to 6 cm. long), porrect, white or somewhat yellowish; flower, including ovary, 6 cm. long, yellow; petals oblong, mucronate; ovary bearing few large areoles, these filled with brown wool and yellow glochids; filaments short; style thick, 2 cm. long, with 10 stigma-lobes; fruit pubescent, 4 cm. long.

Very common on the hills in the coastal plain of western Mexico from southern Sonora to southern Sinaloa, Mexico, where it was frequently collected by Rose, Standley, and Russell in 1910; their No. 13546, with flower, from Fuerte, Sinaloa, is selected as the type of the species. It is named for Dr. Glover B. Wilcox, who first sent in living specimens in 1909.

Figure 211 represents a joint of the type specimen.

FIG. 211.—Opuntia wilcoxii. ×0.4.

To this series belong two plants which we have not been able to identify but are here briefly characterized:

The first, a very peculiar species, collected by Rose, Standley, and Russell, March 14, 1910 (No. 12853), on the dry hills near Alamos, Sonora, Mexico, is unlike any of the described species. It is living both in Washington and New York, but it has not done well in cultivation. It may be described as follows:

Bushy; joints oblong, thickish, pale green in color, with very short puberulence, nearly or quite spineless; glochids yellowish or greenish, numerous; young areoles brown in the center, white-woolly in the margin; flowers and fruit not known.

Dr. H. H. Rusby collected the second species on the Balsas River, southern Mexico. It comes from the region of *O. velutina*, but we do not know its flowers. It may be described as follows:

Joints oblong, 18 cm. long, but cultivated specimens smaller, usually obovate, dark green; spines few, short, at first white; young areoles large, bordered with white wool, bearing the spines and glochids from the center.

Living specimens are growing in the New York Botanical Garden under No. 32811.

Series 17. TOMENTOSAE.

Tall, erect, pubescent or puberulent species, with flat persistent joints, the spines, when present, white. We know three species, natives of Mexico and Guatemala.

M. E. Eaton del

1. Upper part of flowering joint of *Opuntia leptocarpa*.
2. Fruit of the same.
3. Flowering joint of *Opuntia velutina*.
4. Upper part of joint of *Opuntia megacantha*.

(All natural size.)

Key to Species.

Joints narrowly obovate.
Joints grayish green, densely velvety ..... 190. *O. tomentosa*
Joints bright green, minutely puberulent ..... 191. *O. tomentella*
Joints broadly obovate ..... 192. *O. guilanchi*

190. Opuntia tomentosa Salm-Dyck, Observ. Bot. 3: 8. 1822.

Cactus tomentosus Link, Enum. Hort. Berol. 2: 24. 1822.
Opuntia oblongata Wendland in Pfeiffer, Enum. Cact. 161. 1837.
Opuntia icterica Griffiths, Monatsschr. Kakteenk. 23: 138. 1913.

Becoming 3 to 6 meters high or more, with a broad top and a smooth trunk 10 to 30 cm. in diameter; joints oblong to narrowly obovate, 10 to 20 cm. long, velvety pubescent, somewhat tuberculate when young; glochids yellow; spines usually wanting but sometimes 1 or more appear; flowers orange-colored, 4 to 5 cm. long; filaments white or rose-colored; style dark carmine, longer than the stamens; stigma-lobes 5 or 6, white; fruit ovoid, red, sweetish; seeds 4 mm. broad.

Fig. 212.—Opuntia tomentosa.

Type locality: Not cited; doubtless Mexico.

Distribution: Central Mexico and as an escape in Australia.

This species was first described from cultivated plants and has long been a favorite. When grown out of doors, as it is in Bermuda, it forms a large and conspicuous plant. It is usually nearly or quite spineless, but plants which come from the Valley of Mexico are often spiny.

According to J. H. Maiden, this plant had been sent to him under the unpublished name *Opuntia lurida*, and as *O. pubescens*.

Illustrations: Agr. Gaz. N. S. W. 23: pl. opp. 1028; Monatsschr. Kakteenk. 16: 121; De Candolle, Pl. Succ. Hist. 2: pl. 137 [A, B], this last as *Cactus cochenillifer* (*fide* Berger).

Plate XXXIII, figure 1, represents a fruiting joint of a plant raised from seeds received by the United States Department of Agriculture. Figure 212 is from a photograph of a plant near St. Georges, Bermuda, taken by Stewardson Brown in 1912.

191. Opuntia tomentella Berger, Monatsschr. Kakteenk. 22: 147. 1912.

Bushy; joints obovate to oblong, 20 to 30 cm. long, 9 to 15 cm. broad, light green, somewhat shining, finely puberulent; areoles about 3 cm. apart, small; spines 1 or 2, acicular, white, short (7 to 10 mm. long), porrect, sometimes wanting; glochids few; flowers numerous, 5 to 6 cm. long; petals obovate, reddish yellow; filaments yellowish green; style rose-colored; stigma-lobes white; ovary tomentose, armed with numerous black glochids; fruit oblong, red, sour.

Type locality: In Guatemala.

Distribution: Guatemala.

This species was distributed by the late F. Eichlam, who sent plants both to Washington and to La Mortola, those sent to La Mortola being used by Mr. Berger for his description. The species is perhaps near the common Mexican species *O. tomentosa*, but does not grow so tall, and the tomentum is not so dense nor so soft.

Figure 213 represents a joint of a plant collected in Guatemala by F. Eichlam in 1909.

FIG. 213.—Opuntia tomentella. ×0.4.

192. Opuntia guilanchi Griffiths, Rep. Mo. Bot. Gard. 19: 265. 1908.

Becoming 1.5 to 2 meters high, often with a distinct trunk 1.5 to 2.5 cm. in diameter; joints broadly obovate, 14 to 16 cm. wide, 20 to 24 cm. long, minutely pubescent; spines at first white, slightly flattened, the longest 2 cm. long; glochids light yellow; fruit subglobose, 4 cm. in diameter, pubescent, variously colored, aromatic.

Type locality: Near the city of Zacatecas, Mexico.

Distribution: Zacatecas, Mexico.

Series 18. LEUCOTRICHAE.

This series is restricted to a single species. Schumann grouped as *Chaetophorae*, *O. leucotricha* with *O. ursina*, the latter a species with similar long bristles on the stem but otherwise very different, it being dry-fruited. *Opuntia leucotricha* is characterized by its long, weak, hair-like or bristle-like spines on many of the joints, especially the stem and very old joints. The fruit of this plant is very different from that of related series in that the pulp is fragrant and does not come free from the rind when mature.

193. Opuntia leucotricha De Candolle, Mém. Mus. Hist. Nat. Paris 17: 119. 1828.

Opuntia fulvispina Salm-Dyck in Pfeiffer, Enum. Cact. 164. 1837.
Opuntia leucotricha fulvispina Weber in Schumann, Gesamtb. Kakteen Nachtr. 157. 1903.

Often 3 to 5 meters high, with a large top; trunk as well as the older joints covered with long white bristles; joints oblong to orbicular, 1 to 2 cm. long, pubescent; areoles closely set, the upper part filled with yellow glochids, the lower part at first with only 1 to 3 weak white spines; flowers, including ovary, 4 to 5 cm. long; petals yellow, broad; ovary with numerous areoles, the upper ones bearing long, bristly glochids (1 cm. long); style red; stigma-lobes green; fruit variable, 4 to 6 cm. long, white or red, the rind not easily coming off from the pulp, aromatic, edible.

Type locality: In Mexico.

Distribution: Central Mexico.

Opuntia erythrocentron Lemaire (Förster, Handb. Cact. 492. 1846) was given as a synonym of *O. fulvispina*.

Opuntia leucosticta Wendland (Pfeiffer, Enum. Cact. 167, 1837) probably belongs here.

Opuntia leucacantha Link and Otto (Salm-Dyck, Hort. Dyck. 362. 1834), published first in 1834—although the name occurs in literature as early as 1830 (Verh. Ver. Beförd.

1. Upper part of joint of *Opuntia tomentosa*. 2, 3. Flowering joint and branch of *Opuntia brasiliensis*.
4. Joint of *Grusonia bradtiana*. (All natural size.)

Gartenb. 6: 434. 1830)—which was later taken up as *Consolea leucacantha* by Lemaire (Rev. Hort. 1862: 174. 1862), seems to belong here rather than to *O. spinosissima*. If it came from Mexico, as reported, it could not be *O. spinosissima* or any of its relatives, for none of them is known from Mexico.

Opuntia subferox Schott (Pfeiffer, Enum. Cact. 167. 1837) was given as a synonym of this species, while *O. leucacantha laevior* Salm-Dyck (Cact. Hort. Dyck. 1844. 47. 1845) and *O. leucacantha subferox* Salm-Dyck (Förster, Handb. Cact. 497. 1846) were supposed to be based on *O. subferox*.

Opuntia leucantha (De Candolle, Prodr. 3: 474. 1828), unpublished, is doubtless the same as *O. leucacantha*.

FIG. 214.—Opuntia leucotricha.

Opuntia fulvispina laevior Salm-Dyck (Pfeiffer, Enum. Cact. 164. 1837) and *O. fulvispina badia* Salm-Dyck (Cact. Hort. Dyck. 1849. 65. 1850) are given as synonyms of *O. leucotricha;* while *O. rufescens* Salm-Dyck (Förster, Handb. Cact. 493. 1846) is given as a synonym of *fulvispina laevior;* all these seem to belong here.

This is called durasnilla in Mexico. It is grown in Bermuda under the name of Aaron's Beard.

Illustrations: Engler and Prantl, Pflanzenfam. 3^{6a}: f. 56, J; N. Mex. Agr. Exp. Sta. Bull. 60: pl. 4, f. 1, 2.

Plate XXXIV, figure 1, represents a flowering joint of a plant in the collection of the New York Botanical Garden. Figure 214 is from a photograph of a plant grown from a cutting received from the collection of M. Simon, St. Ouen, Paris, France, in 1901.

Series 19. ORBICULATAE.

We have retained the series *Criniferae*, although changing its name to *Orbiculatae*, but we have excluded *O. scheeri*, which was placed here by Schumann. The species are characterized by long hairs produced from the areoles. The species retained in the series are not closely related; while others, like *O. macrocentra*, in other series, sometimes produce long hairs from the areoles in the seedling stage, and *O. hyptiacantha* and some other species have a few hairs at the areoles of mature joints.

KEY TO SPECIES.

Hairs from the areoles of young plants long and white, long-persistent; plant low.. 194. *O. orbiculata*
Hairs from the areoles of young joints of old plants early deciduous; plant tall... 195. *O. pilifera*

194. Opuntia orbiculata Salm-Dyck in Pfeiffer, Enum. Cact. 156. 1837.

Opuntia crinifera Salm-Dyck in Pfeiffer, Enum. Cact. 157. 1837.
Opuntia crinifera lanigera Pfeiffer, Enum. Cact. 157. 1837.
Opuntia lanigera Salm-Dyck, Cact. Hort. Dyck. 1849. 65. 1850.

A plant without a very definite trunk, about 1 meter high, often broader than high; joints green or bluish green, orbicular to obovate, sometimes spatulate, about 15 cm. long; leaves subulate, 2 to 3 mm. long; areoles small, in seedlings and young plants producing long white hairs or wool long-persistent; spines acicular, several, yellow; flowers yellow.

Type locality: Cited as Brazil, but undoubtedly by error.

Distribution: Northern Mexico.

Opuntia senilis Parmenteer is given by Pfeiffer (Enum. Cact. 157. 1837) as a synonym of *O. crinifera*, and *O. pintadera* by Salm-Dyck (Cact. Hort. Dyck. 1844. 47. 1845) as a synonym of *O. lanigera*. They doubtless both belong here.

Opuntia metternichii Piccioli (Salm-Dyck, Cact. Hort. Dyck. 1844. 46. 1845) and *O. orbiculata metternichii* Salm-Dyck (Cact. Hort. Dyck. 1849. 68. 1850), names without descriptions, doubtless belong here.

We have studied living plants sent from the Berlin Botanical Garden as *O. crinifera* and from the Botanical Garden of Santiago, Chile, as *O. orbiculata;* the plant is not native in Chile.

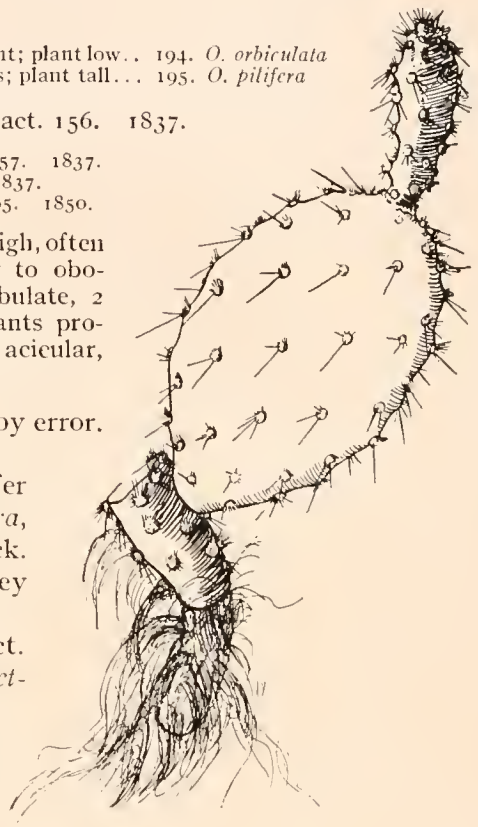


FIG. 215.—Opuntia orbiculata. ×0.66.

Illustration: Monatsschr. Kakteenk. 11: 155, as *Opuntia lanigera.*

Figure 215 represents joints of a plant sent from the Berlin Botanical Garden in 1902.

195. Opuntia pilifera Weber, Dict. Hort. Bois 894. 1898.

Becoming 4 to 5 meters high, with a definite, thick, woody, cylindric trunk and a broad, rounded top; joints oblong to orbicular, 1 to 3 dm. long, obtuse at apex, pale green; leaves subulate, about 5 mm. long; areoles 2 to 3 cm. apart, scarcely elevated; spines 2 to 9, white, slightly spreading, acicular; the outer part of the areole filled with nearly white, more or less deciduous hairs 2 to 3 cm. long; flowers large, red; areoles on the ovary bearing brown glochids and deciduous hairs, the latter especially abundant towards the top of the ovary; fruit red, juicy.

Type locality: In Mexico.

Distribution: Puebla, Mexico.

No definite locality was given for this species when it was first described, and apparently no type material was preserved; living specimens identified by Weber are still grown at La Mortola, Italy. The species is common about Tehuacán, Mexico, being one of the large forms occurring in that region. It is common in all large greenhouse collections.

Figure 216 is from a photograph of a plant in the collection of the New York Botanical Garden grown from a cutting brought by Dr. MacDougal and Dr. Rose from Tehuacán, Mexico, in 1906.

Series 20. FICUS-INDICAE.

Large plants, usually with large, nearly spineless green joints; spines, when present, few, small, white; flowers large, usually orange to yellow. None of the species is definitely known in the wild state, but all doubtless originated from tropical American ancestors, and they may all represent spineless races of plants here included in our series *Streptacanthae*. Some of them are cultivated for their fruit and others for forage.

Key to Species.

Joints obovate to elliptic, comparatively broad, more or less glaucous.
  Joints dull.
    Joints thin, up to 5 dm. long.. 196. *O. ficus-indica*
    Joints thick, 15 cm. long or less. 197. *O. crassa*
  Joints glossy..... 198. *O. undulata*
Joints elongated, comparatively narrow.
  Flowers yellow; joints somewhat tuberculate..... 199. *O. lanceolata*
  Flowers orange-red; joints not tuberculate..... 200. *O. maxima*

Fig. 216.—Opuntia pilifera.

196. Opuntia ficus-indica (Linnaeus) Miller, Gard. Dict. ed. 8. No. 2. 1768.

Cactus ficus-indica Linnaeus, Sp. Pl. 468. 1753
Cactus opuntia Gussone, Fl. Sic. Prodr. 559 1827–8. Not Linnaeus.
Opuntia vulgaris Tenore, Syll. Fl. Neap. 239. 1831. Not Miller.
Opuntia ficus-barbarica Berger, Monatsschr. Kakteenk. 22: 181. 1912.

Large and bushy or sometimes erect and tree-like and then with a definite woody trunk up to 5 meters high, usually with a large top; joints oblong to spatulate-oblong, usually 3 to 5 cm. long, sometimes even larger; areoles small, usually spineless; glochids yellow, numerous, soon dropping off; leaves subulate, green, 3 mm. long; flowers large, normally bright yellow, 7 to 10 cm. broad; ovary 5 cm. long; fruit normally red, edible, 5 to 9 cm. long, with a low, depressed umbilicus.

Type localtiy: Tropical America.

Distribution: Native home not known, but now found all over the tropics and subtropics either as cultivated plants or as escapes. It is hardy in Bermuda and Florida.

This cactus is widely cultivated in all tropical and subtropical countries, where it is grown for its fruits and for forage. It has run wild in many waste places along the Mediterranean Sea, about the Red Sea, in southern Africa, and in Mexico.

We have not attempted to list the many named garden varieties of this species, which are sometimes Latin and sometimes English in form.

Opuntia amyclaea ficus-indica (Berger, Monatsschr. Kakteenk. 15: 154. 1905) has never been described.

The origin of this common, cultivated species doubtless dates back to prehistoric times. We have long been convinced that it is a close relative of the *Streptacanthae*, and have kept it out of that series as only a matter of convenience. Mr. A. Berger believed it to be a spineless form of *O. amyclaea*, which is now a well-established species in certain parts of Italy. Dr. Griffiths has recently figured a reversion which appeared on the common

spineless form which points very definitely to *O. megacantha* as the origin of this form. (See Reversion in Prickly Pears, Journ. Hered. 5: 222. 1914.)

Illustrations: Amer. Garden 11: 471; Bull. U. S. Dept. Agr. 31: pl. 1; pl. 2, f. 1; Cycl. Amer. Hort. Bailey 3: f. 1543; Dept. Agr. N. S. W. Misc. Publ. 253: pl. [1], f. 1, 3; Dict. Gard. Nicholson 2: f. 753; Dodon. Pempt. f. 10, 11; Lemaire, Cact. f. 10; Meehan's Monthly 10: 28; Mem. Acad. Neap. 6: pl. 1, 2; Monatsschr. Kakteenk. 15: 151; W. Watson, Cact. Cult. f. 8, in part; f. 80.

FIG 217.—Opuntia ficus-indica, Córdoba, Argentina.

Figure 217 is from a photograph of the plant growing at Córdoba, Argentina, taken by Paul G. Russell in 1915; figure 218 represents the fruit, obtained in Bermuda by Dr. Britton in 1913.

197. **Opuntia crassa** Haworth, Suppl. Pl. Succ. 81. 1819.

Opuntia parvula Salm-Dyck, Hort. Dyck. 364. 1834.
Opuntia crassa major Pfeiffer, Enum. Cact. 153. 1837.
Opuntia glauca Forbes, Hort. Tour Germ. 158. 1837.

Plant 1 to 2 meters high, somewhat branched; joints ovate to oblong, 8 to 12.5 cm. long, thick, bluish green, glaucous; areoles bearing brown wool and brown glochids; spines wanting or sometimes 1 or 2, acicular, 2.5 cm. long or less; flowers and fruit unknown.

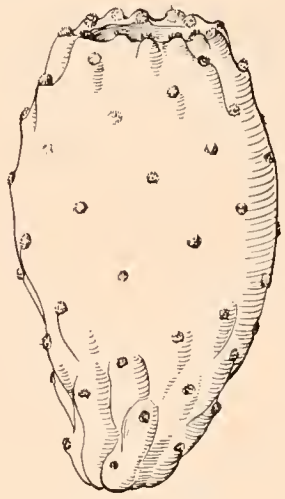


FIG. 218.—Fruit of Opuntia ficus-indica. ×0.66.

Type locality: Described from cultivated specimens supposed to have come from Mexico.

Distribution: Unknown in the wild state; locally found in cultivation in tropical America.

Haworth, who first described this species, thought it to be near *O. stricta*.

Pfeiffer (Enum. Cact. 153. 1837) uses *O. glaberrima* Hort. Berol. as a synonym of *O. crassa major*.

Opuntia parvula, when first published, was supposed to be native of Chile, but this was a mistake. Salm-Dyck compared the species with *O. crassa* and *O. spinulifera*, but says it is thrice smaller than either. Schumann refers *O. parvula* directly to *O. crassa*, which disposition we follow.

Figure 219 is from a photograph of a plant in the Organ Mountains, Rio de Janeiro, Brazil, taken by Paul G. Russell in 1915.

198. Opuntia undulata Griffiths, Rep. Mo. Bot. Gard. 22: 32. 1912.

Opuntia undosa Griffiths, Monatsschr. Kaktenk. 23: 139. 1913.

"Plant tall, large, stout, open-branching, with cylindrical trunk, often 30 cm. or more in diameter; joints very large, obovate, broadly rounded above, widest above middle, commonly 35 by 55 cm., firm, hard, quite fibrous, dished, wavy or flat, glossy light yellowish green at first, but changing through a darker green with a slight touch of glaucous to scurfy brown on old trunks; leaves subcircular in section, subulate, pointed, usually tinged with red at the tip, about 4 mm. long, upon a prominent tubercle and subtending a prominent dark-brown areole; areoles subcircular to ellipsoid or obovate, about 3.5 by 4.5 mm., gray, 5 to 6 cm. apart; spicules yellow in a short, compact tuft in upper part of areole, about 1 mm. long, soon becoming dirty and inconspicuous; spines white, few, short, erect, flattened, straight or twisted, 10 to 15 mm. long, 1 to 3 or 4, mostly one or none; fruit large, 4 to 5 by 9 to 10 cm., dull red to slightly tinged with orange and pulp streaked with red and orange when rind is removed."

FIG. 219.—Opuntia crassa.

Type locality: Described from cultivated plant obtained at Aguascalientes, Mexico.

Distribution: Mexico.

Illustrations: Rep. Mo. Bot. Gard. 22: pl. 11, in part; pl. 12.

We have doubtfully referred to this species plants collected by Dr. Rose on the west coast of Mexico, where they were growing wild; this is some distance from the place where the type was obtained from cultivated plants. These specimens are like this species in having quite glossy joints with few spines. The plants were not in bloom when seen by Dr. Rose in the spring of 1910.

Dr. Griffiths has changed his first name, *O. undulata*, on account of the use of that name at an earlier time, which was not accompanied, however, by description.

199. Opuntia lanceolata Haworth, Syn. Pl. Succ. 192. 1812.

Cactus lanceolatus Haworth, Misc. Nat. 188. 1803.
Cactus elongatus Willdenow, Enum. Pl. Suppl. 34. 1813.
Opuntia elongata Haworth, Suppl. Pl. Succ. 81. 1819.

Plants tall, much branched; joints elongated, 3.5 cm. long, dull green, somewhat tuberculate; areoles distant, small; spines if present few, small, white, 1 cm. long or less; glochids yellow; flowers large, yellow.

Type locality: In South America.

Distribution: Known only in cultivation.

We have combined *O. lanceolata* and *O. elongata*, although there is a possibility of their being different. *O. lanceolata* was first described essentially as follows: Joints flattened, suberect, subnaked, with leaves 3 lines long; stems at first erect; joints lanceolate, green, when young with many leaves; spines (spicules?) in fascicles, the shortest of all species (except *Cactus coccinelliferi*); leaves longer than in other species.

The species was received by Haworth from W. Anderson; no habitat given. In 1812 Haworth calls it the spear-shaped *Opuntia*. He says it probably came from South America,

and flowers in July. It had been in cultivation before 1796; it flowered in 1808 with Haworth and was described as follows: Flowers shiny yellow; filaments yellow, half as long as petals; style longer than stamens; stigmas 5, thick, obtuse, 2 lines long, sulphur-colored.

De Candolle says the flowers are 4 inches in diameter.

Pfeiffer states the joints are 5 to 6 inches long by 1 to 1.5 inches broad; that the leaves are red and the spicules yellow.

Opuntia elongata laevior Salm-Dyck (Cact. Hort. Dyck. 1849. 242. 1850) may or may not belong here.

FIG. 220.—Opuntia maxima.

200. **Opuntia maxima** Miller, Gard. Dict. ed. 8. No. 5. 1768.

Cactus decumanus Willdenow, Enum. Pl. Suppl. 34. 1813.
Opuntia decumana Haworth, Rev. Pl. Succ. 71. 1821.
Opuntia gymnocarpa Weber, Dict. Hort. Bois 893. 1898.
Opuntia labouretiana Console* in Schumann, Gesamtb. Kakteen 717. 1898.
Opuntia ficus-indica decumana Spegazzini, Anal. Mus. Nac. Buenos Aires III. 4: 512. 1905.
Opuntia ficus-indica gymnocarpa Spegazzini, Anal. Mus. Nac. Buenos Aires III. 4: 512. 1905.

Forming large, much branched plants; joints elongated, more or less spatulate, 35 cm. long or more, 10 to 12 cm. broad, rounded at apex, somewhat cuneate at base, pale green, not at all tuberculate; areoles small, distant; spines sometimes wanting or sometimes 1 or 2, short, white; glochids yellow (brown in some specimens referred here); flowers conspicuous, 8 cm. broad, orange-red; ovary elongated, 7 to 8 cm. long, bearing numerous large glochids.

*Berger (Hort. Mortol. 409. 1912) says this is known as *O. labouretiana* Console.

M. E. Eaton del.

1. Part of joint of *Opuntia leucotricha*.
2. Part of joint of *Opuntia maxima*.
3. Joint of *Opuntia lasiacantha*.
4. Joint of *Opuntia robusta*.

(All natural size.)

Type locality: In America.

Distribution: Known only in cultivation.

Opuntia maxima Miller was described as the largest of all the opuntias and as the name is older than any of those here cited, it is taken up for this species. Haworth was uncertain whether or not his *O. decumana* is distinct from Miller's *O. maxima*, although in the Index Kewensis the two are considered the same; Burkill considered them distinct, but his idea of *O. decumana* is the *O. ficus-indica* type. Mr. Berger, on the other hand, states that it is evidently of the *O. dillenii* group, but this is hardly warranted by the description. Berger is convinced that *O. elongata* is distinct from *O. decumana*.

Opuntia labouretiana macrocarpa (Cat. Darrah Succ. Manchester 55. 1908) is only a garden name.

Plate XXXIV, figure 2, represents a flowering joint of a plant presented to the New York Botanical Garden by Frank Weinberg in 1901, which bloomed in May 1916. Figure 220 is from a photograph of the same plant.

Opuntia bartramii Rafinesque (Atl. Journ. 1: 146. 1832) is based on Bartram's description (Travels p. 163. 1790), in which he states that the plant is 7 to 8 feet high; joints very large, bright green, glossy; spines none; glochids numerous; flowers large, yellow; fruit pear-shaped, purple. It was found about 6 miles from Lake George, northern Florida, associated with *Zamia pumila* and *Erythrina*. We do not know of any *Opuntia* answering the description, growing in Florida at the present time. Dr. Small visited the type locality in 1918 but failed to find any plant answering Rafinesque's description.

Opuntia hernandezii De Candolle (Mém. Hist. Nat. Paris 17: 69. pl. 16. 1828) is a complex. The reference to Hernandez applies to *Nopalea cochenillifera*. Schumann was not able to identify the plant illustrated by De Candolle, but thought it might be referable to *Opuntia ficus-indica*, in which we agree.

Series 21. STREPTACANTHAE.

Tall, branched, glabrous, green species with white or faintly yellow, acicular or subulate spines, large yellow or red flowers, and fleshy fruits, natives of Mexico and Central and South America. We recognize twelve species. The fruits, known as tunas, are mostly edible and are sold in large quantities in Mexican markets, a practice which probably dates from prehistoric time. The long-continued selection of plants for their fruit has perpetuated many slightly differing races.

Key to Species.

Spines short, 5 mm. to 8 cm. long.
- Joints scarcely if at all tuberculate.
  - Joints obovate to elliptic, mostly not more than twice as long as wide.
    - Areoles close together, sunken ..... 201. *O. spinulifera*
    - Areoles not close together, not sunken.
      - Joints dull.
        - Spines acicular ..... 202. *O. lasiacantha*
        - Spines subulate.
          - Areoles with 2 or more short reflexed hairs or bristles at the lower part of the areoles.
            - Spines strongly depressed; areoles with several hairs ..... 203. *O. hyptiacantha*
            - Spines not strongly depressed; areoles with 1 or 2 hairs.
              - Joints obovate ..... 204. *O. streptacantha*
              - Joints oblong ..... 205. *O. amyclaea*
          - Areoles without reflexed hairs or bristles.
            - Spines clear white, terete or nearly so; fruit spineless, 6 to 8 cm. long, yellow, edible ..... 206. *O. megacantha*
            - Spines white to dull yellow, somewhat flattened; fruit 6 cm. long or less bearing a few spines near the top, red, not edible.
              - Plant with a definite trunk; petals reddish; fruit spiny only at top 207. *O. deamii*
              - Plant bushy; petals chocolate-colored; fruit spiny all over .... 207a. *O dobbieana*
      - Joints shining ..... 208. *O. eichlamii*
  - Joints oblong to oblanceolate, some of them much longer than wide.
    - Joints shining; wool of young areoles white; petals yellow ..... 209. *O. inaequilateralis*
    - Joints dull; wool of young areoles brown; petals deep orange to scarlet ..... 210. *O. pittieri*
- Joints strongly tuberculate ..... 211. *O. cordobensis*

Spines elongated, 10 to 14 cm. long ..... 212. *O. quimilo*

201. Opuntia spinulifera Salm-Dyck, Hort. Dyck. 364. 1834.

Opuntia candelabriformis Martius in Pfeiffer, Enum. Cact. 159. 1837.
Opuntia oligacantha Salm-Dyck, Cact. Hort. Dyck. 1849. 241. 1850.

Tall, much branched plants; joints orbicular to oblong, sometimes obovate, 20 to 30 cm. long, glabrous, a little glaucous; leaves small, red, 4 to 6 mm. long; areoles on young joints usually small, sometimes longer than broad, the margin at first bordered with cobwebby hairs, afterwards short white hairs, either spineless or with short white bristle-like spines; areoles on old joints more or less sunken, rather close together; spines on old joints 1 to 3, 1 to 2 cm. long, subulate, bone-colored.

Type locality: In Mexico.

Distribution: Mexico.

We have seen no wild specimens of this species, but Mr. Berger has grown it at La Mortola, Italy, and has distributed specimens now growing in New York and Washington.

So-called *Opuntia candelabriformis* and *O. oligacantha* are also in cultivation; but the original descriptions indicate that these two species should be merged into *O. spinulifera*, and plants so determined in European collections support this view. In so far as we have been able to ascertain, no type specimens of any of the three supposed species are extant. Schumann (Gesamtb. Kakteen 740. 1898) describes the flowers of *O. candelabriformis* as purple, 6 to 7 cm. broad. *Opuntia candelabriformis rigidior* Salm-Dyck (Cact. Hort. Dyck. 1849. 68. 1850), an unpublished variety, may belong here.

Figure 221 represents a joint of a plant presented to the New York Botanical Garden by Mrs. George Such in 1900.

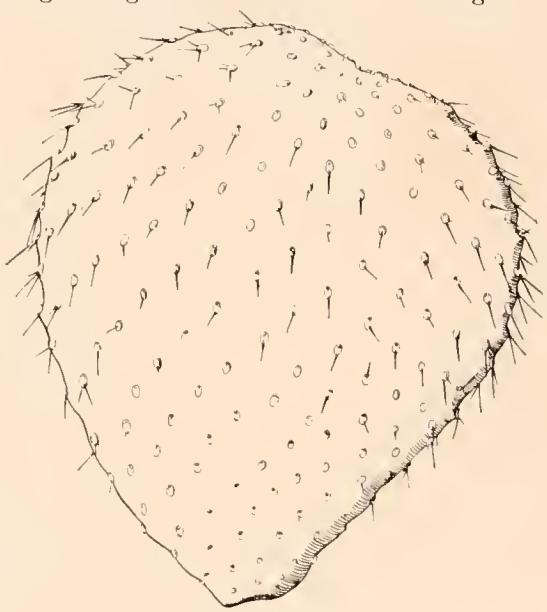


FIG. 221.—Opuntia spinulifera. ×0.4.

202. Opuntia lasiacantha Pfeiffer, Enum. Cact. 160. 1837.

Opuntia megacantha lasiacantha Berger, Bot. Jahrb. Engler 36: 453. 1905.

A tall plant, with a more or less definite trunk; joints obovate to oblong, 20 to 30 cm. long; leaves short, red; areoles small, 2 to 3 cm. apart; spines usually 1 to 3, acicular, white, 2 to 4 cm. long, slightly spreading; glochids numerous, prominent, dirty yellow to brown; flowers large, yellow or deep orange, 6 to 8 cm. broad; ovary bearing long, brown, deciduous bristles, especially from the upper areoles; style pinkish; stigma-lobes pale green.

Type locality: In Mexico.

Distribution: Central Mexico.

Schumann refers *O. lasiacantha* to *O. robusta*, but wrongly, as Berger states, and as living plants show. Pfeiffer said it is near *O. candelabriformis*, here taken up under *O. spinulifera*.

This species is very variable and, while it seems distinct from *O. megacantha*, it is to be noted that Mr. Berger referred it to that species as a variety.

Opuntia chaetocarpa Griffiths (Proc. Biol. Soc. Washington 27: 25. 1914), in its few long white spines, resembles plants collected by Dr. Rose in southern Mexico which we have referred to this species.

Illustration: Addisonia 3: pl. 90.

Plate XXXIV, figure 3, represents a flowering joint of a plant collected by Dr. Rose near the City of Mexico in 1906. Figure 222 represents a joint of a plant collected by Dr. MacDougal and Dr. Rose at Tehuacán, Mexico, in 1906.

OPUNTIA ZACUAPANENSIS Berger, Hort. Mortol. 413. 1912.

"A fine new species with bright-orange flowers. We received this plant a few years ago from M. L. Puteaux, Versailles, as *Opuntia spec.* from Zacuapan.* Joints 13 to 20 cm. long and 9.5 cm. broad, obovate, smooth, glossy green, areoles 15 to 25 mm. distant, slightly elevated, small, roundish or obovate. Spicules yellow, short, not numerous. Spines generally two, white, with yellowish points and base, terete, the lower deflexed shorter, the upper one spreading (2–) 3 cm. long. Flowers numerous from the top of the joint, 7.5 cm. long and 6.5 cm. broad, ovary obovate turbinate, 3.5 to 4 cm. long and 22 mm. broad, areoles somewhat elevated, prickly; petals obovate lanceolate, acute and aristate, orange-yellow, with a more reddish-brown hue along the midrib on the back and as well on the shorter obtuse outer petals; stamens yellow, style yellowish, thickened or clavate above the base, stigmata (6–) 7, dirty rose-coloured."

We have studied a plant, sent from La Mortola to the New York Botanical Garden in 1913, which has not flowered; it appears to be related to *O. lasiacantha.*

Figure 223 represents a joint from the plant received from La Mortola, Italy, in 1913.

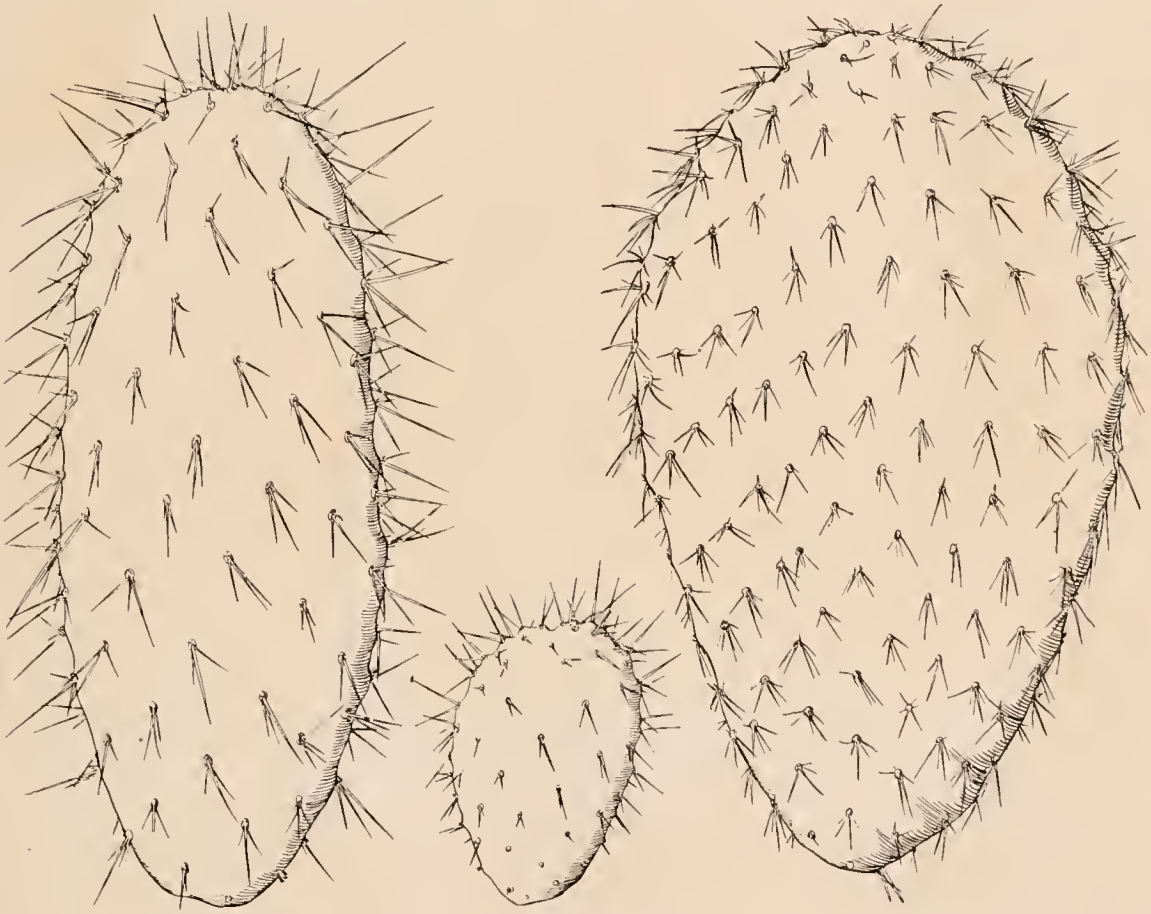


FIG. 222.—Opuntia lasiacantha. ×0.4.

FIG. 223.—Opuntia zacuapanensis. ×0.4.

FIG. 224.—Opuntia hyptiacantha. ×0.5.

203. Opuntia hyptiacantha Weber, Dict. Hort. Bois 894. 1898.

Opuntia nigrita Griffiths, Rep. Mo. Bot. Gard. **21**: 169. 1910.
? *Opuntia cretochaeta* Griffiths, Proc. Biol. Soc. Washington **29**: 11. 1916.

A tall, much branched plant, but in cultivation often only 1 meter high; joints oblong to obovate, 20 to 30 cm. long, pale green, but when young bright green; spines on young joints single, porrect, and accompanied by 2 or 3, sometimes many, white, slightly pungent hairs; spines on old joints

*Perhaps Zacualpan, in Vera Cruz, Mexico.

4 to 6 (in the original description 8 to 10), somewhat spreading or appressed, 1 to 2 cm. long; glochids few, brownish; areoles small, 1.5 cm. apart; leaves small, brownish; flowers red; fruit globular, yellowish, its areoles filled with long, weak glochids; umbilicus broad, only slightly depressed.

Type locality: In Mexico.

Distribution: Oaxaca, Mexico.

This species is very near *Opuntia streptacantha*, and in many cases it is difficult to separate them. It is also near *O. pilifera*, but the areoles are not so hairy. Weber, who first described it, gives no definite locality for the species; but Dr. Rose has examined, at La Mortola, Italy, a living plant sent by Weber which seems to be the same as one of the large opuntias from Tehuacán, Mexico.

Opuntia chavena Griffiths (Rep. Mo. Bot. Gard. 19: 264. pl. 23, in part. 1908) is a near relative of *O. hyptiacantha* or not distinct from it.

Illustration: Rep. Mo. Bot. Gard. 21: pl. 24, as *Opuntia nigrita*.

Figure 224 represents a joint of a plant obtained for the New York Botanical Garden from the collection of M. Simon, St. Ouen, Paris, France, in 1901.

204. Opuntia streptacantha Lemaire, Cact. Gen. Nov. Sp. 62. 1839.

Much branched, up to 5 meters high, sometimes with a trunk 45 cm. in diameter; joints obovate to orbicular, 25 to 30 cm. long, dark green; areoles small, rather close together for this group; spines numerous, spreading or some of them appressed, white; glochids reddish brown, very short; flowers 7 to 9 cm. broad, yellow to orange, the sepals reddish; filaments greenish or reddish; stigma-lobes 8 to 12, green; fruit globular, 5 cm. in diameter, dull red or sometimes yellow, both within and without.

Type locality: Not cited.

Distribution: Very common on the Mexican table-lands, especially on the deserts of San Luis Potosí.

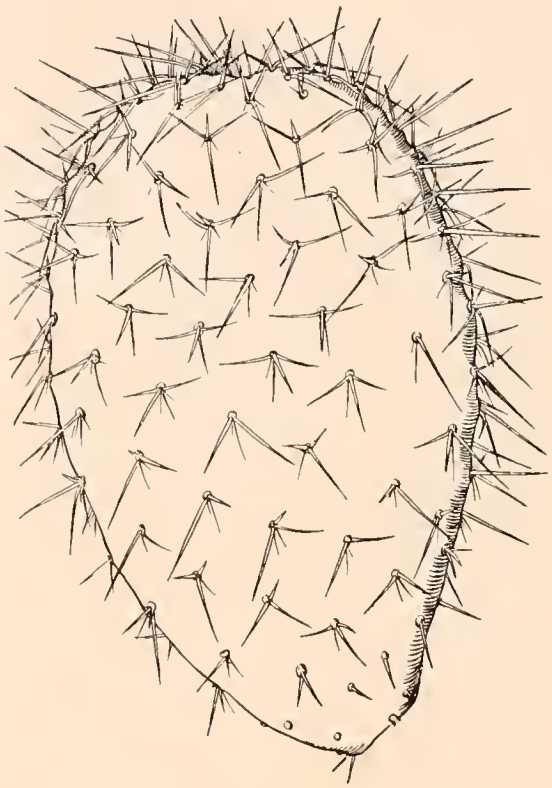


FIG. 225.—Opuntia streptacantha. ×0 5.

This species is known as tuna cardona or nopal cardón, and is one of the most important economic opuntias in Mexico. It has many forms and seems to grade into some of the species which we have here recognized.

Opuntia cardona Weber (Dict. Hort. Bois 895. 1898) and *O. coindettii* Weber (Dict. Hort. Bois 895. 1898) are two names given as synonyms of the species by Weber, but they were never published. *O. diplacantha* (Berger, Hort. Mortol. 232. 1912) must be referred here, but of this, so far as we know, there is no published description. Berger has distributed living specimens which we are inclined to refer here.

Opuntia pachona Griffiths (Rep. Mo. Bot. Gard. 21: 168. pl. 22. 1910) is closely related to *O. streptacantha*, if not a race of that species. *Opuntia megacantha tenuispina* Salm-Dyck (Cact. Hort. Dyck. 1844. 45. 1845) was given as a new name for *O. lasiacantha*, but was never described.

Illustrations: N. Mex. Agr. Exp. Sta. Bull. 60: pl. 1; Safford, Ann. Rep. Smiths. Inst. 1908: pl. 9, f. 6; U. S. Dept. Agr. Bur. Pl. Ind. Bull. 102[1]: pl. 1; 116: pl. 1, this last as tuna cardona; Engler and Prantl, Pflanzenfam. 3[6a]: f. 70, this last as *Opuntia pseudotuna*.

Figure 225 represents a joint of a plant received from C. Wercklé in 1902 as *O. cardona*.

205. Opuntia amyclaea Tenore, Fl. Neap. Prodr. App. 5: 15. 1826.

Opuntia ficus-indica amyclaea Berger, Hort. Mortol. 411. 1912.

Erect; joints oblong to elliptic, 3 to 4 dm. long, about twice as long as broad, thick, dull green, a little glaucous; leaves 4 mm. long, acute, red; areoles small, with 1 or 2 short bristles from the lower parts of areoles; spines 1 to 4, stiff, nearly porrect, usually less than 3 cm. long, white or horn-colored, the stoutest angled; glochids brown, soon disappearing; flowers yellow; fruit yellowish red, not very juicy.

Type locality: Described from specimens grown in Italy.

Distribution: Doubtless Mexico, but not known in the wild state.

Our description is based on the original description and a specimen collected by A. Berger near Palermo, where it is grown as a hedge plant. Berger's plant suggests very much *O. streptacantha*, but is not quite so spiny; it does not suggest very much *O. ficus-indica*, where Berger has placed it. Our description of the spines is taken from Berger's plant, while the original description states that the spines are 3 to 8, stout, spreading, unequal, white, the longest 35 mm. long.

O. alfagayucca (Salm-Dyck, Cact. Hort. Dyck. 1849. 68. 1850) and *O. alfayucca* (Rümpler in Förster, Handb. Cact. ed. 2. 938. 1885) were given as synonyms of *O. amyclaea*.

FIG. 226.—Opuntia megacantha.

206. Opuntia megacantha Salm-Dyck, Hort. Dyck. 363. 1834.

Opuntia castillae Griffiths, Rep. Mo. Bot. Gard. **19**: 261. 1908.
? *Opuntia incarnadilla* Griffiths, Rep. Mo. Bot. Gard. **22**: 27. 1912.

Plant tall, 4 to 5 meters high or more, with a more or less definite woody trunk; joints of large plants obovate to oblong, often oblique, sometimes 40 to 60 cm. long or more, but in greenhouse specimens often much smaller, pale dull green, slightly glaucous; leaves minute, often only 3 mm. long, green or purplish; areoles rather small, on large joints often 4 to 5 cm. apart, when young bearing brown wool; spines white, usually 1 to 5, slightly spreading, sometimes nearly porrect, usually only 2 to 3 cm. long, sometimes few and confined to the upper areoles; glochids few, yellow, caducous, sometimes appearing again on old joints; flowers yellow to orange, about 8 cm. broad; ovary spiny or spineless, obovoid; fruit 7 to 8 cm. long.

FIG. 227—Opuntia megacantha on Lanai, Hawaiian Islands.

Type locality: In Mexico.

Distribution: Much cultivated in Mexico; grown also in Jamaica and southern California and escaped from cultivation in Hawaii.

This species was originally described by Salm-Dyck essentially as follows: Erect and of the size of *O. decumana;* joints 17.5 cm. long by 7.5 cm. broad and 2.5 cm. or more thick; areoles close together, filled with gray wool; glochids brownish, becoming blackish; spines 7 to 10, white, unequal, acicular, somewhat radiating, the longest one deflexed, 5 cm. long; flowers not known; leaves small, reddish.

Opuntia megacantha trichacantha Salm-Dyck was given as a synonym of this species by Förster (Handb. Cact. 486. 1846), but was never published.

Opuntia tribuloides Griffiths (Monatsschr. Kakteenk. 23: 137. 1913), according to the description, is of this relationship.

This is the chief Mission cactus. It is the one from which the best varieties of edible tunas are obtained and is one of the commonest cultivated opuntias in Mexico, having numerous forms, many of them bearing local names.

Illustrations: Ariz. Agr. Exp. Sta. Bull. 67: pl. 8, f. 2; Rep. Mo. Bot. Gard. 19: pl. 24, both as *Opuntia castillae.* Rep. Mo. Bot. Gard. 22: pl. 4, 5, these two as *Opuntia incarnadilla;* Amer. Journ. Bot. 4: 572. f. 6.

Plate XXXII, figure 4, represents a flowering joint of a plant in the same collection received from Fairmount Park, Philadelphia, in 1905. Figure 226 is from a photograph of a plant in the collection of the New York Botanical Garden;

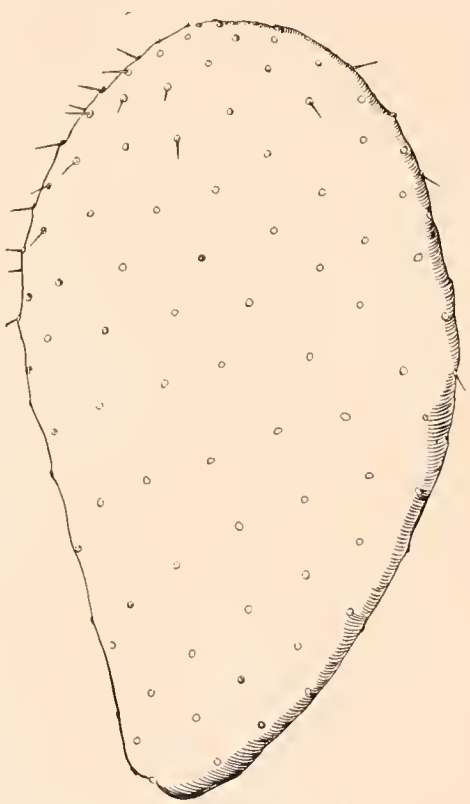


FIG 228.—Opuntia megacantha. ×0.4.

figure 227 is from a photograph taken by A. S. Hitchcock on Lanai in 1916; figure 228 represents a joint of a plant obtained by Dr. MacDougal near Mount Wilson, California, in 1906, a nearly spineless form.

207. Opuntia deamii Rose, Contr. U. S. Nat. Herb. **13**: 309. 1911.

One meter or so high, with a definite cylindric trunk, branching a short distance above the base; branches few, ascending; joints erect or spreading, very large, obovate to oblanceolate, 25 to 30 cm. long, at first bright leaf-green, in age dark green, glabrous; areoles remote, often 4 cm. apart, rather small; spines 2 to 6, usually 4, white or dull yellow, stout, somewhat flattened, spreading or porrect, 3 to 5.5 cm. long; flowers 7 cm. long, reddish; fruit oblong, 6 cm. long, naked, except for a few spines near the top, wine-red both within and without, not edible; seeds small, 3 mm. broad.

Type locality: Fiscal, Guatemala.

Distribution: Fiscal to San José de Golfo and Sanarata, Guatemala.

Illustration: Contr. U. S. Nat. Herb. **13**: pl. 65.

Figure 229 represents a joint of the type specimen.

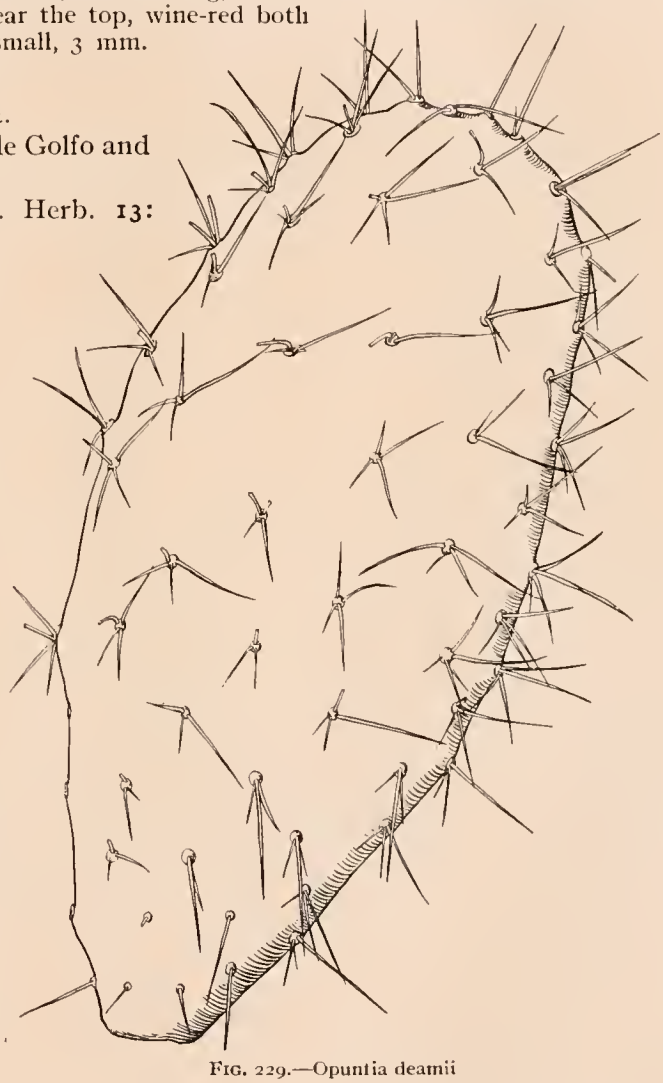


FIG. 229.—Opuntia deamii

A tall, white-spined *Opuntia*, closely resembling the Mexican *O. macracantha*, was obtained by Dr. Rose in 1918 (No. 22390) along roadsides at Ambato, Ecuador, presumably escaped from cultivation; its fruit is edible.

207*a*. Opuntia dobbieana sp. nov. (See Appendix, p. 225.)

208. Opuntia eichlamii Rose, Contr. U. S. Nat. Herb. **13**: 310. 1911.

Tree-like, 5 to 6 meters high, the main branches nearly erect; joints obovate to orbicular, 15 to 20 cm. long, more or less glaucous, especially in dried specimens; leaves minute, caducous; areoles small, 3 to 3.5 cm. apart; spines 4 to 6, very unequal, 2 cm. long or less, rose-colored at first, soon becoming white, spreading, the larger ones flattened; glochids brown; flower 3.5 cm. long; petals carmine; style red; stigma-lobes 8 to 11, bright green; fruit 4 cm. long, strongly tuberculate, not edible.

Type locality: Near Guatemala City.

Distribution: Suburbs of Guatemala City, Guatemala.

Illustration: Contr. U. S. Nat. Herb. **13**: pl. 66.

Figure 230 represents a joint of the type specimen.

209. Opuntia inaequilateralis Berger, Bot. Jahrb. Engler **36**: 453. 1905.

About 12 dm. high, with spreading branches; joints oblique, narrowly ovate to subrhomboid, 40 to 70 cm. long, 2 to 4 times as long as wide, narrowed at base, obtuse at apex, with somewhat

sinuate margins, green, shining; young joints bright green, not at all glaucous, oblanceolate to narrowly oblong, rounded at apex; leaves reddish, subulate, 2 to 3 mm. long; areoles small, circular, filled with white wool when young, and having white, somewhat cobwebby hairs on the outer edge; glochids brown, in a dense cluster; spines 3 to 7, acicular on young joints, but finally 10 to 15, stout, 3 to 4 cm. long, at first yellowish, becoming white, somewhat spreading but not appressed to the joint; flowers large, borne at the apex of the joints; petals yellow, broadly obovate, retuse with crenulate margins; stigma-lobes green; fruit oblong, truncate, reddish, juicy, sweet.

Type locality: Described from cultivated specimens grown at La Mortola, Italy.
Distribution: Known only from cultivated specimens, their origin unknown.
Illustration: Figure 231 shows a joint of a plant sent from La Mortola, Italy, in 1913.

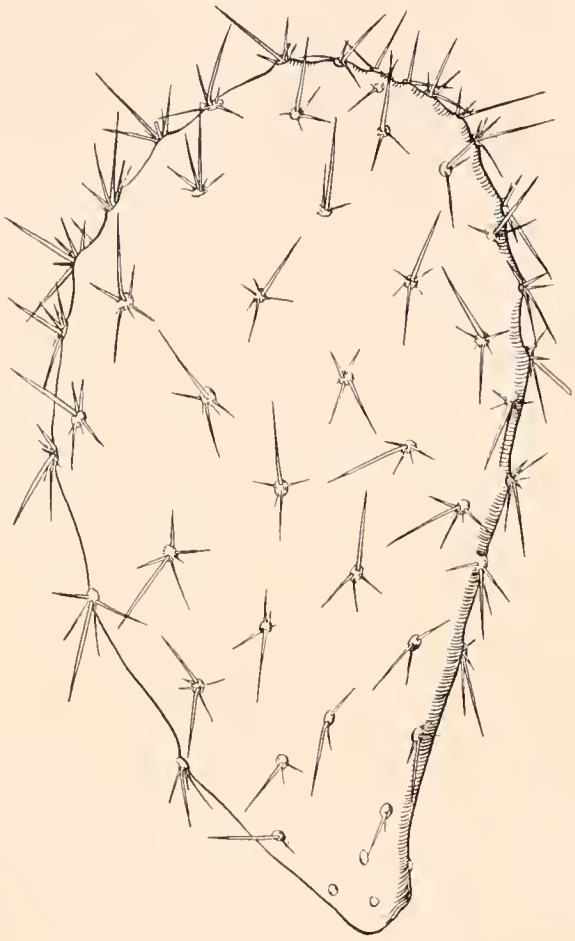


FIG. 230.—Opuntia eichlamii. ×0.5.

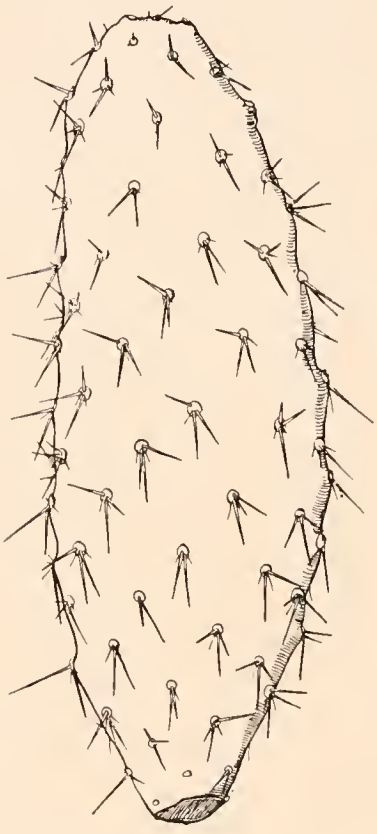


FIG. 231.—Opuntia inaequilateralis. ×0.5.

210. Opuntia pittieri sp. nov.

Plant up to 5 meters high, with a rather definite cylindric spiny trunk; joints large, 25 to 50 cm. long, 2 to 4 times as long as wide, narrowly oblong, green; leaves subulate, with purple tips; wool in young areoles dark brown to purple; areoles elevated, rather large, 2 to 3 cm. apart; spines 3 to 6, slightly spreading, acicular, white, the longest 2 to 2.5 cm. long; glochids tardily developing, few, often wanting; flowers deep orange, turning to scarlet; ovary nearly globular, more or less spiny, nearly truncate at apex.

Collected at Venticas del Dagua, Dagua Valley, western cordillera of Colombia, February 1906, by H. Pittier, and since grown in Washington and New York.

Opuntia pittieri differs from *O. inaequilateralis* in having the young joints thinner, somewhat tuberculate, and with longer leaves; the areoles, too, are filled with brown or purple wool, while the glochids develop more slowly or never appear.

Figure 232 represents a joint of the type plant.

211. Opuntia cordobensis Spegazzini, Anal. Mus. Nac. Buenos Aires III. 4: 513. 1905.

Much branched, the trunk 1 to 2 meters long, 20 cm. in diameter, very spiny; joints large, 3 dm. long or more, broadly oblong to obovate; areoles prominent, numerous; spines 1 to 6, white, somewhat spreading, a little flattened and twisted; flowers usually on the margins of the joints; petals about 12, yellow; fruit pyriform, yellowish both within and without, 8 cm. long; seeds about 3 mm. long.

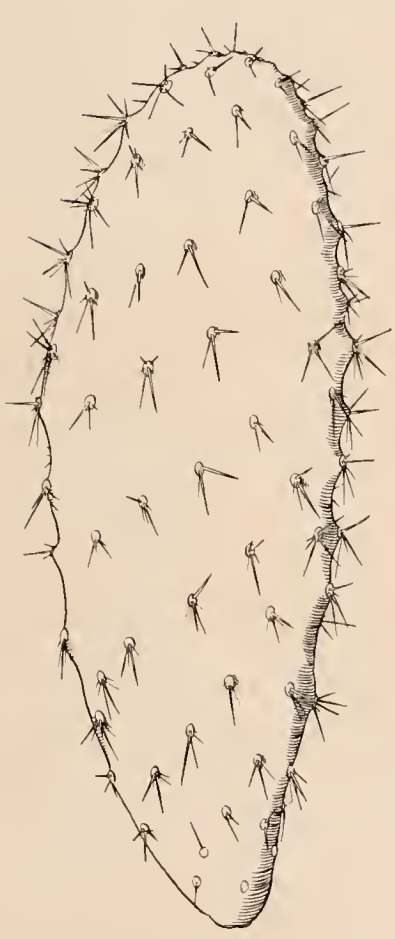


FIG. 232.—O. pittieri. ×0.4.

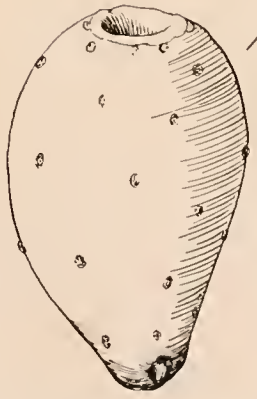


FIG. 234.—Fruit of O. cordobensis. ×0.7.

FIG. 233.—O. cordobensis. ×0.4.

Type locality: Near Córdoba, Argentina.

Distribution: Northern Argentina.

The only white-spined species observed by Dr. Rose in 1915 about Córdoba were *O. ficus-indica*, in cultivation, and what we have taken to be *O. cordobensis*. The latter is very abundant, growing on the hills about the city, and sometimes planted as hedges. Dr. Spegazzini states that it has the habit of *O. labouretiana*.

Figure 233 represents a joint of the plant collected by Dr. Rose near Córdoba, Argentina, in 1915; figure 234 represents the fruit as collected by J. A. Shafer at Calilegua, Argentina, in 1917 (No. 197).

212. **Opuntia quimilo** Schumann, Gesamtb. Kakteen 746. 1898.

Much branched, about 4 meters high; joints large, elliptic or obovate, 5 dm. long by 2.5 dm. broad, 2 to 3 cm. thick, grayish green; spines very long, usually 1, sometimes 2 or 3 from an areole, twisted, 7 to 14.5 cm. long; flowers red, 7 cm. broad; fruit pear-shaped to globular, 5 to 7 cm. long, greenish yellow; seeds 8 mm. broad, 1.5 to 2 mm. thick, with broad, thick, white margins.

Type locality: La Banda, Santiago del Estero, Argentina.
Distribution: Northern Argentina.
This plant is known to the natives as quimilo.

Dr. Rose obtained a good photograph of it from Dr. J. A. Dominguez, and seed and a photograph from Dr. Spegazzini. While the volume was going through the press a fine specimen in fruit with the long spines so characteristic of this species was obtained by H. M. Curran at Quilino, Córdoba, Argentina. Dr. Shafer's specimens collected at Río Piedras, show that the trunk-areoles sometimes bear as many as eight spines.

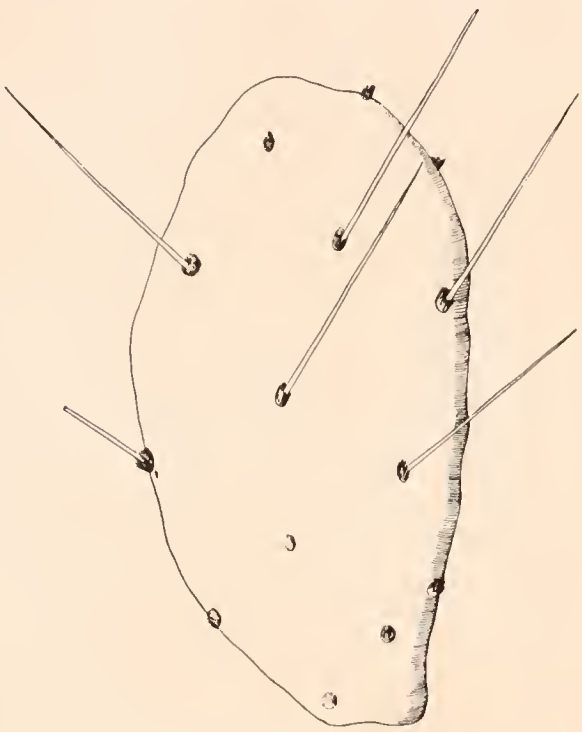


FIG. 235.—Joint of Opuntia quimilo. ×0.3.

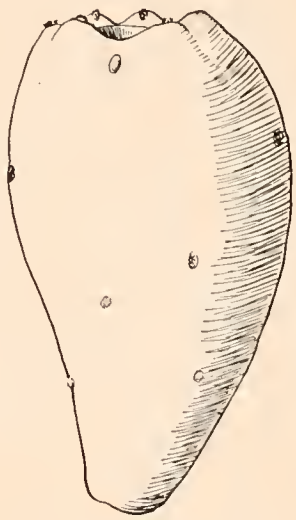


FIG. 236.—Fruit of Opuntia quimilo. ×0.3.

Figure 235 represents a joint obtained by Dr. Shafer at Río Piedras, Salta, Argentina, January 4, 1917 (No. 34); figure 236 represents the fruit from the same plant; figure 237 is from a photograph of a flowering joint of the plant, contributed by Dr. Spegazzini.

The following may belong to this series:

OPUNTIA ITHYPETALA Griffiths, Bull. Torr. Club 43: 529. 1916.

Tall, erect plant, 2 meters or more high; joints large, obovate, 26 to 45 cm. long, 14 to 19 cm. broad, much contracted below, bright dark green, somewhat tuberculate at the areoles; subulate, 5 to 6 mm. long; areoles large, often 1 cm. in diameter, 4 to 5 cm. apart; spines white at least on second year's growth, 3 to 5; central spine largest, porrect, 3 to 4 cm. long; flowers yellow, fading to rose-purplish; petals erect, 3 cm. in diameter; style white; stigma-lobes 6, light green.

Known only from cultivated plants received from the Berlin Botanical Garden.

Series 22. ROBUSTAE.

Tall or large plants with blue or bluish green joints, the spines, when present, white or yellowish. Two of the species are widely distributed in warm regions through cultivation for their edible fruits; the other is known in cultivation only in central Mexico. All are presumably Mexican in origin.

KEY TO SPECIES.

Joints orbicular to broadly obovate or elliptic.
  Fruit deep red, 7 to 9 cm. in diameter. 213. *O. robusta*
  Fruit greenish white, 4 to 5 cm. in diameter ..... 214. *O. guerrana*
Joints oblong, narrowed at both ends.. 215. *O. fusicaulis*

213. Opuntia robusta Wendland in Pfeiffer, Enum. Cact. 165. 1837.

Opuntia flavicans Lemaire, Cact. Gen. Nov. Sp. 61. 1839.
Opuntia larreyi Weber in Coulter, Contr. U. S. Nat. Herb. 3: 423. 1896.
Opuntia gorda Griffiths, Monatsschr. Kakteenk. 23: 134. 1913.

Often erect, sometimes 5 meters high, usually much branched; joints orbicular to oblong, 20 to 25 cm. long by 10 to 12.5 cm. broad, very thick, bluish green, glaucous; leaves 4 mm. long, reddish, acute; spines 8 to 12, stout, very diverse, brown or yellowish at base, white above, up to 5 cm. long, but often wanting on greenhouse specimens; flowers 5 cm. broad, yellow; stigma-lobes green; fruit globular to ellipsoid, at first more or less tuberculate, deep red, 7 to 9 cm. long.

Type locality: In Mexico.

Distribution: Central Mexico; cultivated in Argentina.

This is one of the few species of *Opuntia* of which we have not been able to verify the original publication. It was redescribed by Pfeiffer in 1837.

FIG. 237.—Opuntia quimilo.

Opuntia camuessa Weber (Dict. Hort. Bois 895. 1898) was given as a synonym of *O. robusta*, but was never described; and the same is true of *O. piccolominiana* Parlatore (Schumann, Gesamtb. Kakteen 741. 1898).

The variety *Opuntia robusta viridior* Salm-Dyck (Förster, Handb. Cact. 487. 1846) was never described.

Opuntia albicans Salm-Dyck (Hort. Dyck. 361. 1834) we do not know, but A. Berger, who has grown a plant under that name at La Mortola, says it is closely related to *O. robusta*, while in the New York Botanical Garden are specimens labeled *O. albicans* which are difficult to distinguish from *O. ficus-indica*. Here belong the following: *O. prate* Sabine (Pfeiffer, Enum. Cact. 155. 1837), given as a synonym of *O. albicans; O. albicans lacvior* Salm-Dyck (Cact. Hort. Dyck. 1849. 67. 1850), name only; and *O. pruinosa* Salm-Dyck (Cact. Hort. Dyck. 1849. 67. 1850) given as a synonym of *O. albicans lacvior*.

Opuntia larreyi, a manuscript name of Weber, which was published by Coulter in 1896, is based on the plant known to the Mexicans as camuessa. Weber gave it the name of *O. camuessa*, as shown above, but did not publish it; it is usually considered to be only a race of *O. robusta*, but Dr. Griffiths considers it a distinct species, even referring it to a different series, the *Ficus-indicae* (N. Mex. Agr. Exp. Sta. Bull. 64: 56. 1907).

Berger remarks that this species is very variable, but that it can not well be divided even into varieties.

Opuntia megalarthra Rose (Smiths. Misc. Coll. **50**: 529. 1908), in its very spiny joints, yellow spines, and small fruits, seems very different from the common cultivated *O. robusta;* yet when grown in the greenhouse for several years it takes on much the appearance of *O. robusta.* If this view is correct, *O. megalarthra* represents the wild form of the species.

Opuntia cochinera Griffiths (Rep. Mo. Bot. Gard. **19**: 263. pl. 26. 1908) from Zacatecas, Mexico, is, perhaps, a hybrid between *Opuntia robusta* and one of the *Streptacanthae.*

Illustrations: N. Mex. Agr. Exp. Sta. Bull. **60**: pl. 5, f. 1; Monatsschr. Kakteenk. **23**: 135; Journ. Inter. Gard. Club **3**: 14, the last two as *Opuntia gorda;* U. S. Dept. Agr. Bur. Pl. Ind. Bull. **74**: pl. 5, as Tapuna pear. ? N. Mex. Agr. Exp. Sta. Bull. **64**: pl. 1.

Plate XXXIV, figure 4, represents a joint of the plant collected by Dr. Rose in Hidalgo, Mexico, in 1905, and described by him as *Opuntia megalarthra.* Figure 238 is from a photograph taken in Zacatecas, Mexico, by Professor F. E. Lloyd in 1908.

FIG. 238.—Opuntia robusta.

214. **Opuntia guerrana** Griffiths, Rep. Mo. Bot. Gard. **19**: 266. 1908.

Plant 9 to 12 dm. high, with an open, branching top; joints oblong to orbicular, 15 to 25 cm. long, thick, glaucous; areoles 5 mm. in diameter, filled with tawny wool; spines white to yellow, 1 to 6, flattened, twisted; petals yellow; filaments greenish white; stigma-lobes green; fruit globose greenish white, 4 to 5 cm. in diameter.

Type locality: Near Dublán, Hidalgo, Mexico.

Distribution: Known only from type locality.

Except in size and color of fruit this species is very much like the common *Opuntia robusta* of this part of Mexico.

215. **Opuntia fusicaulis** Griffiths, Rep. Mo. Bot. Gard. **19**: 271. 1908.

Plant 5 meters high or less, the branches erect or spreading; joints oblong, elongated, 4 dm. long or less, much longer than wide, glaucous, bluish green, spineless, narrowed at both ends; glochids often wanting; areoles small, filled with tawny wool; fruit greenish white.

Type locality: Described from cultivated plants.

Distribution: Known only from cultivated specimens.

Illustration: Rep. Mo. Bot. Gard. **19**: pl. 23, in part.

The following may be referable to this series:

OPUNTIA CRYSTALENIA Griffiths, Bull. Torr. Club 43: 528. 1916.

Erect, 2 to 2.5 meters high; joints broadly obovate, 25 cm. long, 18 cm. wide, glaucous, bluish green, becoming yellowish in age; leaves 4 mm. long, subulate; spines white, porrect, only on the upper parts of the joints, 1 to 4, usually only 2, the longest 1 to 1.5 cm. long; glochids yellow; flowers yellow; stigma-lobes 10, dark green; fruit subglobose, 4 to 4.5 cm. in diameter.

Type locality: Cardenas, Mexico.
Distribution: Highlands of Mexico, where it is also cultivated.

Series 23. POLYACANTHAE.

This series is confined chiefly to plains of the western United States. The species are all low, creeping plants, very spiny, with dry fruits. On account of the dry fruit this series forms a natural group, although some species in the series *Basilares* also have dry fruits. One species of series *Polyacanthae* has fragile branches, in this respect resembling the *Curassavicae*. The species hybridize with those of the *Tortispinae*.

KEY TO SPECIES.

Joints readily detached, turgid, some of them subterete or subglobose ..... 216. *O. fragilis*
Joints not readily detached, usually flat and thin, or in *O. arenaria* sometimes turgid and nearly terete.
  Joints turgid, usually small ..... 217. *O. arenaria*
  Joints thinner than the last, mostly flat, larger.
    Spines, or some of them, very long, flexible and bristle-like.
      Flowers 4 to 5 cm. long ..... 218. *O. trichophora*
      Flowers 5 to 6 cm. long ..... 219. *O. erinacea*
    Spines stiff, acicular or subulate; areoles distant.
      Spines subulate.
        Fruit naked ..... 220. *O. juniperina*
        Fruit spiny.
          Flowers yellow ..... 221. *O. hystricina*
          Flowers red ..... 222. *O. rhodantha*
      Spines acicular, slender; areoles close together.
        Ovary and fruit without spines ..... 223. *O. sphaerocarpa*
        Ovary and fruit with spines ..... 224. *O. polyacantha*

216. Opuntia fragilis (Nuttall) Haworth, Suppl. Pl. Succ. 82. 1819.

Cactus fragilis Nuttall, Gen. Pl. 1: 296. 1818.
Opuntia brachyarthra Engelmann and Bigelow, Proc. Amer. Acad. 3: 302. 1856.
Opuntia fragilis brachyarthra Coulter, Contr. U. S. Nat. Herb. 3: 440. 1896.
Opuntia fragilis caespitosa and *tuberiformis* Hortus, Stand. Cyc. Hort. Bailey 4: 2363. 1916.
(?) *Opuntia columbiana* Griffiths, Bull. Torr. Club 43: 523. 1916.

Usually low and spreading, small and inconspicuous, but sometimes forming mounds 2 dm high in the center and 4 dm. in diameter, with hundreds of joints; joints fragile (the terminal ones especially breaking off at the slightest touch), often nearly globular but sometimes decidedly flattened, usually dark green, 1 to 4 cm. long; areoles closely set, small, filled with white wool; spines 5 to 7, brown or only with brown tips and lighter below, 1 to 3 cm. long; glochids yellowish; flowers pale yellow, about 5 cm. broad; fruit dry, spiny, 1.5 to 2 cm. long, with a truncate or slightly depressed umbilicus; seeds large, 5 to 7 mm. broad.

Type locality: "From the Mandans to the mountains, in sterile but moist situations."
Distribution: Wisconsin to central Kansas and northwestern Texas, westward to Arizona, Oregon, Washington, and British Columbia.

Dr. Engelmann says "it is rarely found in flower and still more rarely seen in fruit." The only fruit we have seen was collected by Dr. Rose near Liberal, Kansas, in 1912.

Opuntia brachyarthra, sometimes regarded as a variety of *O. fragilis*, we regard as not specifically separable from that species. An examination of the type material now preserved in the Missouri Botanical Garden does not warrant a separation of any kind.

This species is of wide distribution and is especially common on the plains. It usually grows low, often being hidden by the grass. In the grazing country it is a most troublesome weed, for the joints easily break off and become attached by their spines to passing objects, thus greatly annoying and pestering all animals on the range, even frightening

horses. The wide distribution of the species is doubtless largely due to the fact that the joints are so easily scattered. A hybrid with *O. tortispina* has been found in Kansas (Rose, No. 17132).

The plant is of especial interest as the most northern in distribution of the opuntias.

It is stated that *Opuntia cervicornis* Späth (Cat. 156. 1906–7) is "probably a hybrid of which *O. fragilis* is a parent" (Kew Bull. Misc. Inf. 1907: App. 74. 1907). *O. sabinii* (Pfeiffer, Enum. Cact. 147. 1837) was given as a synonym of *O. fragilis*.

Illustrations: Cact. Journ. 1: 100; Dict. Gard. Nicholson 2: f. 752; Förster, Handb. Cact. ed. 2. f. 132; Gartenflora 30: 413; Pac. R. Rep. 4: pl. 12, f. 9; Rümpler, Sukkulenten f. 126; W. Watson, Cact. Cult. f. 78; Wiener Illustr. Gartenz. 10: f. 113, all as *Opuntia brachyarthra*. Illustr. Fl. 2: f. 2532; ed. 2. 2: f. 2991; Pac. R. Rep. 4: pl. 24, f. 5.

Plate XXXV, figure 1, shows old and young joints of the plant collected by C. Birdseye at Florence, Montana, in 1910. Figure 239 is from a photograph of the plant taken by E. R. Warren at San Acacio, Colorado, in 1912.

FIG. 239.—Opuntia fragilis.

217. **Opuntia arenaria** Engelmann, Proc. Amer. Acad. 3: 301. 1856.

Roots in clusters of 10 to 15, spindle-form, somewhat fleshy; stem prostrate, 2 to 3 dm. long, much branched; joints during growing season quite turgid, afterwards much thinner, 4 to 8 cm. long, half as broad as long; areoles large, numerous, filled with brown wool, glochids, and spines; spines 5 to 8 from an areole, 2 or 3 much longer than the others, sometimes 4 cm. long; flowers red, 7 cm. broad; fruit dry, spiny, 3 cm. long; seeds large, 7 cm. broad.

Type locality: Sandy bottoms of the Rio Grande near El Paso.

Distribution: Texas and southern New Mexico.

This species is very rare and has been reported only a few times. Dr. Rose, who has repeatedly collected at El Paso, was never able to find it until October 1913, and then but a single plant about 8 miles above El Paso on the New Mexican side of the Rio Grande. It grows in nearly pure sand not far above the level of the river.

M. E. Eaton del.

1. Plant of *Opuntia fragilis*. 2. Flowering branch of *Opuntia rhodantha*.
3. Flowering joint of *Opuntia polyacantha*. (All natural size.)

Illustration: Cact. Mex. Bound. pl. 75, f. 15.

Figure 240 is from a drawing of the plant collected by Dr. Rose near El Paso, Texas, in 1913.

218. Opuntia trichophora (Engelmann) Britton and Rose, Smiths. Misc. Coll. **50**: 535. 1908.

Opuntia missouriensis trichophora Engelmann, Proc. Amer. Acad. **3**: 300. 1856.
Opuntia polyacantha trichophora Coulter, Contr. U. S. Nat. Herb. **3**: 437. 1896.

A low, spreading plant, often forming small clumps 6 to 10 dm. in diameter; joints orbicular to obovate, 6 to 10 cm. in diameter; areoles closely set; spines numerous, very unequal, the longer one 4 cm. long or so, acicular, pale, often white, but on old joints developing into long, weak hair-like bristles; flowers yellow, the sepals tinged with red; ovary with numerous areoles, these bearing weak, pale bristles; fruit unknown.

Type locality: Mountains near Albuquerque, New Mexico.

Distribution: New Mexico, Texas, and Oklahoma.

This plant, while closely related to *Opuntia polyacantha*, seems worthy of specific rank, its long weak spines being apparently characteristic. Its northern extension into Oklahoma has recently been determined from plants collected by G. W. Stevens.

Illustrations: Pac. R. Rep. **4**: pl. 15, f. 1 to 4; pl. 23, f. 19, all as *Opuntia missouriensis trichophora*.

Figure 241 is copied from the first illustration above cited.

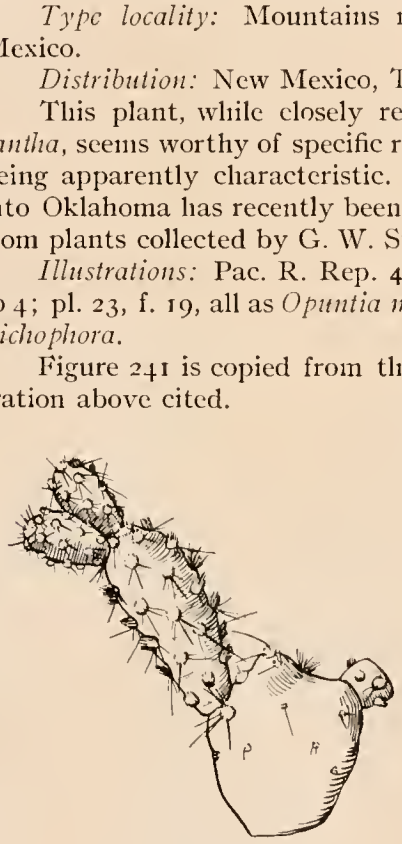


FIG. 240.—Opuntia arenaria. ×0.75.

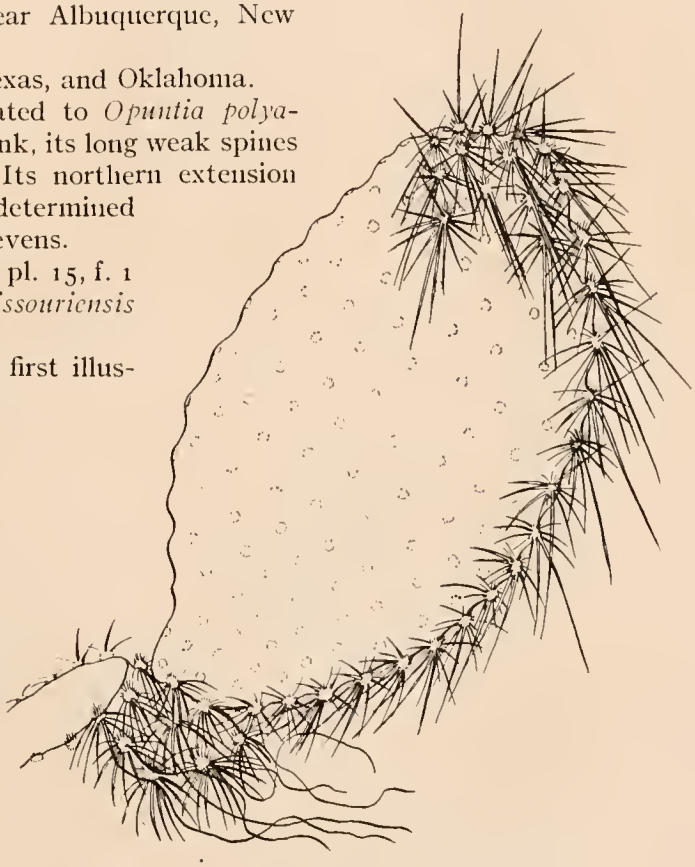


FIG. 241.—Opuntia trichophora. ×0.75.

219. Opuntia erinacea Engelmann, Proc. Amer. Acad. **3**: 301. 1856.

Opuntia ursina Weber, Diet. Hort. Bois 896. 1898.

Growing in small, low clumps, the branches ascending or erect; joints ovate to oblong, flattened or thick, sometimes nearly terete, 8 to 12 cm. long; areoles somewhat tuberculate, large, numerous, closely set, 4 to 10 mm. apart; spines numerous, usually white or sometimes brownish or with brown tips, slender, often 5 cm., sometimes 12 cm. long or even more, stiff, often developing on the old joints as long hairs or bristles; glochids numerous; flowers rather large, 6 to 7 cm. long, either red or yellow; ovary and fruit very spiny; seeds large, rather regular.

Type locality: On Mojave Creek, California.

Distribution: Northwestern Arizona, southern Utah, southern Nevada, and eastern California.

This species has long been passing under the name of *Opuntia rutila* Nuttall (Torrey and Gray, Fl. N. Amer. 1: 555. 1840). Dr. Engelmann referred it there in the Report of Simpson's Expedition (page 442), and again in the Botany of California, with the remark that "this plant seems to be Nuttall's long lost *O. rutila*." And while it is true that the identification of Nuttall's plant is still doubtful, it seems improbable that this reference is correct,

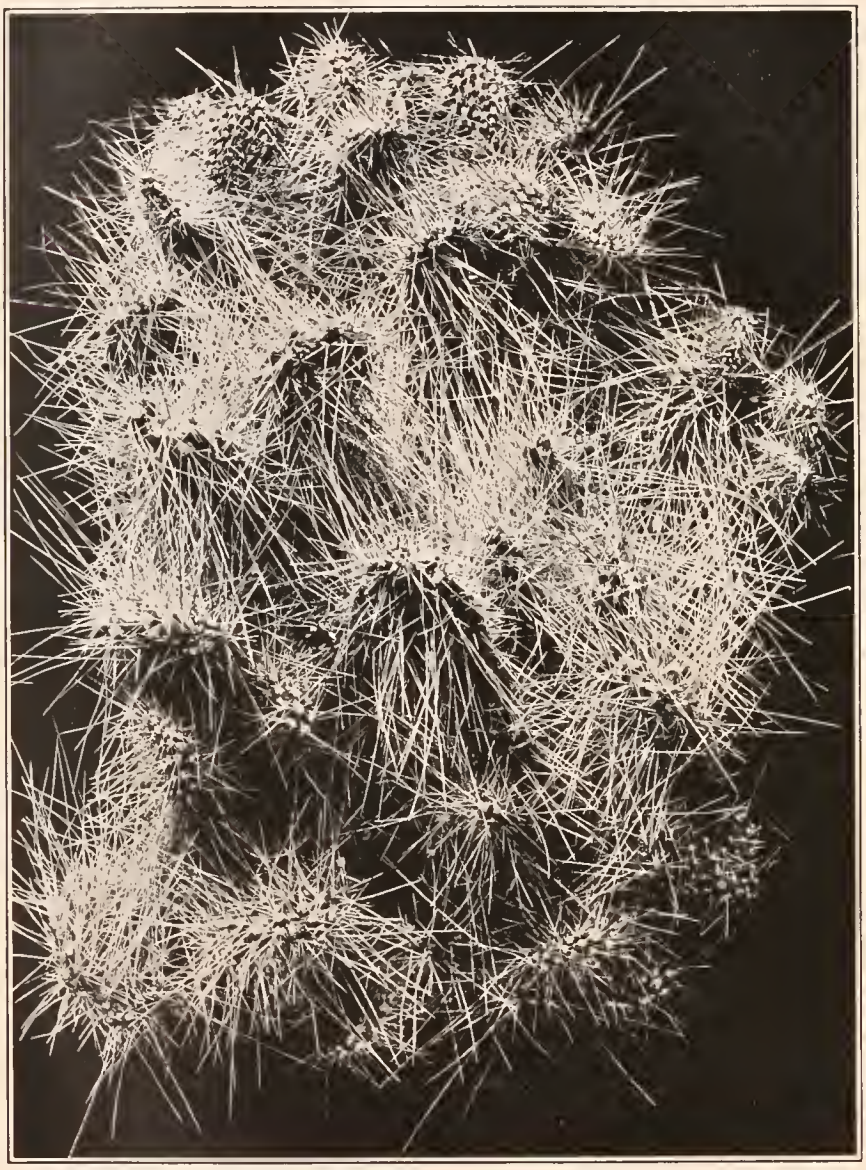


FIG. 242.—Opuntia erinacea.

for the description does not agree with that of the above, and the original station of *O. rutila* in Wyoming is far removed from the other; keen collectors like A. Nelson and V. Bailey, who have searched for the plant for us, have failed to find it in Wyoming. We suspect that *O. rutila* will prove to be *O. polyacantha*.

Opuntia ursina, which comes from the Mojave Desert, seems to be only a slender form with long weak spines. This is known in the trade as the California grizzly bear cactus. Alverson has described it as follows: "This curious plant is covered with tawny white

hairs or flexuous spines, some of which are from 3 to 6 inches long, and I have some extra fine specimens with the spines or hairs 9 and 12 inches long."

Illustrations: Alverson, Cact. Cat. 9 as *Opuntia ursina;* Pac. R. Rep. 4: pl. 13, f. 8 to 11; pl. 24, f. 4.

Figure 242 is from a photograph of the plant taken by F. B. Headley at a point about 29 miles east of Fallon, Nevada, in 1910.

220. Opuntia juniperina sp. nov.

Somewhat of the habit of *Opuntia polyacantha*, but not so procumbent, stouter, and with fewer and stouter spines; joints obovate, 10 to 12 cm. long, broad, rounded at top; areoles small, all below the middle of the joint naked, the upper ones each bearing one stout spine and 1 to several very short accessory ones; the longer spine very stout, 3 to 4 cm. long, brown; flowers not known; fruit dry, oblong, 3 cm. long, spineless, with a shallow, flat umbilicus; seeds large, irregular, 6 to 8 mm. broad.

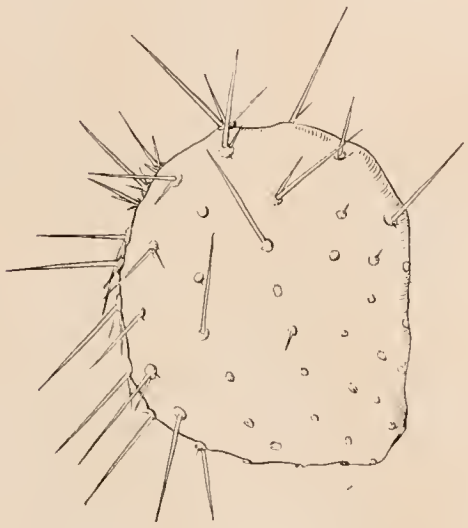


FIG. 243.—Joint of Opuntia juniperina. ×0.5.

FIG. 244.—Seed of same. ×0.5.

FIG. 245.—Opuntia hystricina. ×0.5.

On dry hills among junipers in vicinity of Cedar Hill, San Juan County, New Mexico, altitude about 1,900 meters, August 17, 1911, Paul C. Standley (No. 8051).

This species is nearest *Opuntia rhodantha*, but has stouter joints and much larger seeds.

Figure 243 represents a joint of the type specimen; figure 244 represents a seed.

221. Opuntia hystricina Engelmann and Bigelow, Proc. Amer. Acad. 3: 299. 1856.

More or less diffuse; joints obovate to orbicular, 8 to 20 cm. long; areoles numerous, 10 to 15 mm. apart, rather large; spines numerous, pale brown to white, the longer ones 5 to 10 cm. long, stout, flattish, often reflexed; glochids yellow; flowers 6 cm. long; petals broad, yellow; ovary nearly globular; fruit oblong to obovoid, 2.5 to 3 cm. long, spiny above, dry, with a compressed umbilicus; seeds 7 mm. broad.

Type locality: Colorado Chiquito and on San Francisco Mountains.

Distribution: New Mexico to Arizona and Nevada.

Although this species has a wide range, it is not very well understood; it approaches *O. rhodantha* in some of its forms. We have referred here a very remarkable form collected by E. W. Nelson at Lee's Ferry, Arizona, in 1909. This plant has thick, obovate joints 17

to 22 cm. long, strongly tuberculate, with some of the spines very strong, flattened, and reflexed; the fruit is very spiny; the seeds are 8 mm. broad, angled, with margins thin and acute. This may be the plant listed in Weinberg's catalogue, also from the Grand Canyon, under the name of *Opuntia hochdorfferi*.

Opuntia xerocarpa Griffiths (Proc. Biol. Soc. Washington **29**: 15. 1916), from Kingman, Arizona, is of this relationship, described as "readily distinguished from other species of its dry-fruited allies by its spines, shape of joints and color of plant body."

Illustrations: Pac. R. Rep. 4: pl. 15, f. 5 to 7; pl. 23, f. 15.

Figure 245 is copied from the first illustration above cited.

222. **Opuntia rhodantha** Schumann, La Semaine Hort. 1897.

Opuntia xanthostemma Schumann, Gesamtb. Kakteen 735. 1898.
Opuntia utahensis J. A. Purpus, Monatsschr. Kakteenk. **19**: 133. 1909.

Joints obovate to oblong, 5 to 12 cm. long; areoles distant, 10 mm. apart or more; spines rather stout, 3 or 4, 2 to 3 cm. long, brownish, with 2 or 3 short accessory ones; lower areoles usually naked; glochids brown; flowers, including ovaries, 5 to 6 cm. long, 8 cm. broad; petals red or pink to salmon-colored, obovate, apiculate; stamens red or yellow; fruit spiny; seeds small, 5 mm. in diameter.

Type locality: Colorado, at 2,000 to 2,300 meters altitude.

Distribution: Western Nebraska, Colorado, and Utah.

After a careful examination of living plants of both *O. rhodantha* and *O. xanthostemma*, we feel convinced that the latter is only a form of the other. The color of the stamens in the opuntias does not furnish a constant character. It is hardy in cultivation at New York and highly ornamental when in bloom.

Haage and Schmidt, in their 1915 catalogue, list several varieties of this species: *brevispina, flavispina, pisciformis*, and *schumanniana;* and under *Opuntia xanthostemma* in the same place they list the following varieties: *elegans, fulgens, gracilis, orbicularis*, and *rosea*.

Illustrations: Meehan's Monthly 7: 133; Gartenwelt 1: 83, this last as *Opuntia xanthostemma;* Monatsschr. Kakteenk. **19**: 135, this last as *Opuntia utahensis*.

Plate XXXV, figure 2, represents a flowering plant received by the New York Botanical Garden from Haage and Schmidt, of Erfurt, Germany, in 1913.

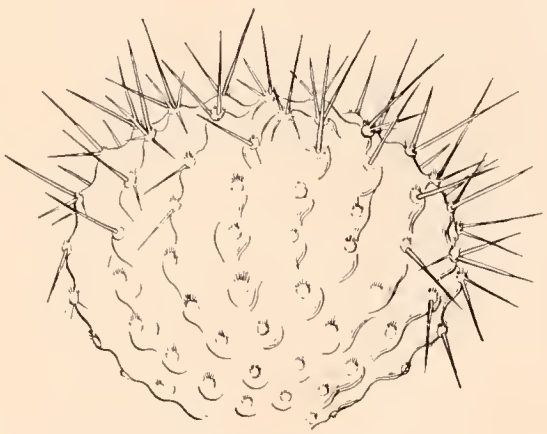


FIG. 246.—Opuntia sphaerocarpa. ×0.66.

223. **Opuntia sphaerocarpa** Engelmann and Bigelow, Proc. Amer. Acad. 3: 300. 1856.

Small, spreading plants; joints orbicular, 6 to 7 cm. broad, thickish, strongly tuberculate, wrinkled in drying, light green or becoming more or less purple; areoles 8 to 10 mm. apart, mostly spineless or the upper and marginal ones bearing short acicular spines, the longest ones about 2 cm. long; glochids yellow; flowers not known; fruit naked, 18 mm. in diameter, with a truncate umbilicus; seeds 5 mm. broad, very irregular.

Type locality: Mountains near Albuquerque, New Mexico.

Distribution: Known only from type locality.

We have not, with certainty, identified any recently collected plants with this species, although some New Mexican specimens appear to be referable to it.

Illustrations: Pac. R. Rep. 4: pl. 13, f. 6, 7; pl. 24, f. 3.

Figure 246 is copied from the first illustration above cited.

224. **Opuntia polyacantha** Haworth, Suppl. Pl. Succ. 82. 1819.

Cactus ferox Nuttall, Gen. Pl. 1: 296. 1818. Not Willdenow. 1813.
Opuntia media Haworth, Suppl. Pl. Succ. 82. 1819.
Opuntia missouriensis De Candolle, Prodr. 3: 472. 1828.
Opuntia splendens Pfeiffer, Enum. Cact. 159. 1837.
Opuntia missouriensis albispina Engelmann and Bigelow, Proc. Amer. Acad. 3: 300. 1856.
Opuntia missouriensis microsperma Engelmann and Bigelow, Proc. Amer. Acad. 3: 300. 1856. Not *O. rafinesquei microsperma* Engelmann, Proc. Amer. Acad. 3: 295. 1856.
Opuntia missouriensis platycarpa Engelmann, Proc. Amer. Acad. 3: 300. 1856.
Opuntia missouriensis rufispina Engelmann and Bigelow, Proc. Amer. Acad. 3: 300. 1856.
Opuntia missouriensis subinermis Engelmann, Proc. Amer. Acad. 3: 300. 1856.
Opuntia polyacantha albispina Coulter, Contr. U. S. Nat. Herb. 3: 437. 1896.
Opuntia polyacantha borealis Coulter, Contr. U. S. Nat. Herb. 3: 436. 1896.
Opuntia polyacantha platycarpa Coulter, Contr. U. S. Nat. Herb. 3: 436. 1896.
Opuntia polyacantha watsonii Coulter, Contr. U. S. Nat. Herb. 3: 437. 1896.
Opuntia schweriniana Schumann, Monatsschr. Kakteenk. 9: 148. 1899.

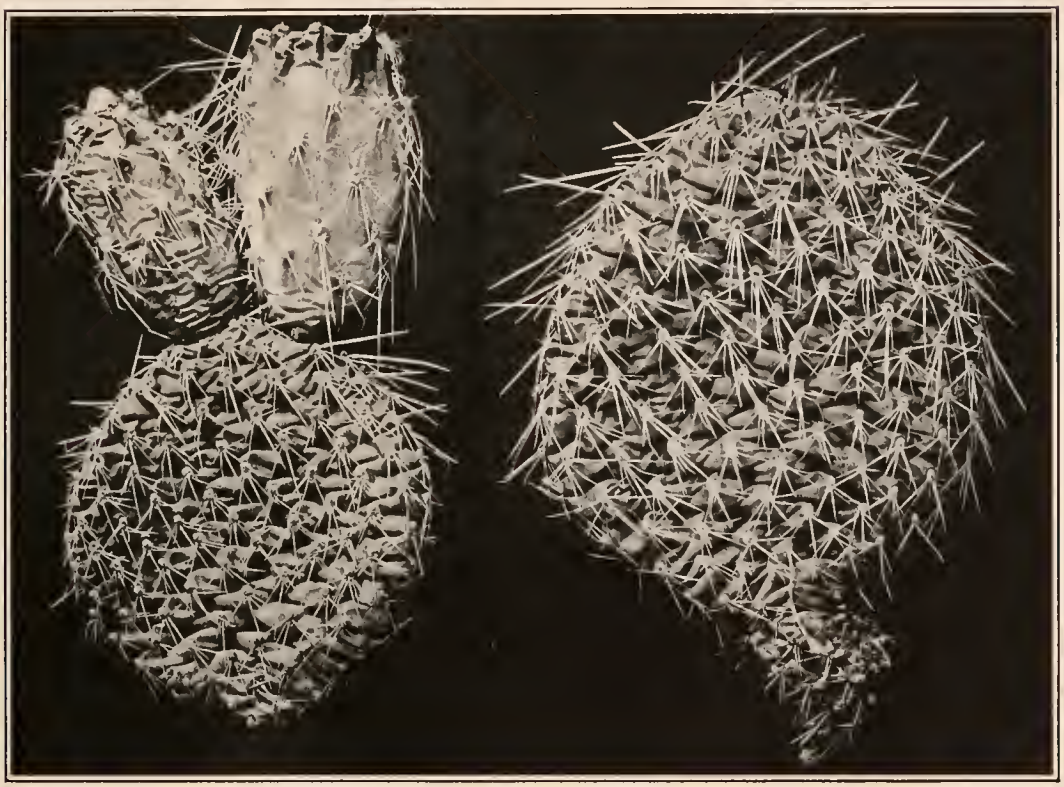


FIG. 247.—Opuntia polyacantha.

Low, spreading plants, with fibrous roots, usually forming small clumps; joints not very thick, orbicular, usually less than 10 cm. in diameter, generally light green; areoles small, closely set, usually less than 1 cm. apart, all spiny; spines numerous, often 9, those from the sides mostly short, appressed, and white, but often 1 or 2 of these elongated and like those from the upper and marginal areoles, dark brown, with lighter tips and about 3 cm. long; glochids yellow; flowers small, 4 to 5 cm. long, including the ovary; sepals tinged with red; petals lemon-yellow; stigma-lobes green; fruit dry, oblong, 2 cm. long, bearing small clusters of white, acicular spines at the areoles; seeds white, 6 mm. long, acute on the margin.

Type locality: Arid situations on the plains of the Missouri.

Distribution: North Dakota to Nebraska, Texas, and Arizona to Utah, Washington, and Alberta.

Opuntia sphaerocarpa utahensis Engelmann (Trans. St. Louis Acad. 2: 199. 1863) can not be referred to *O. sphaerocarpa*, where Dr. Engelmann only provisionally placed it when he first described it. On account of its yellow flowers we have referred it here. *Opuntia*

polyacantha microsperma and *O. polyacantha rufispina*, mentioned in Bailey's Standard Cyclopedia of Horticulture (3: 2363. 1916), belong here.

Opuntia polyacantha was one of the first of our western opuntias to be collected and described. It was first collected by Thomas Nuttall on his memorable trip to the Upper Missouri. He described it in 1818 as *Cactus ferox*, a name which had been previously used by Willdenow, which led A. H. Haworth in 1819 to rename Nuttall's plant, calling it *Opuntia polyacantha*. At the same place Haworth published a second name, *Opuntia media*, undoubtedly based on a less spiny form of *O. polyacantha*. In 1828 Nuttall's plant was again renamed, this time by A. De Candolle, who called it *Opuntia missouriensis*, under which name it was known for many years. In 1896 Dr. John M. Coulter very properly restored Haworth's name *O. polyacantha*.

This species has a wide distribution laterally and altitudinally. It is properly a plains' species, but is found in mountain valleys and on dry hills, usually in the open, but sometimes in sparse pine woods. In a species of such wide distribution and growing under such diverse circumstances, a wide range of forms is to be expected and a number of varieties have been proposed for the various races, some of which may perhaps have red flowers. The plant is hardy at New York, flowering freely in June.

Illustrations: Curtis's Bot. Mag. 115: pl. 7046; Illustr. Fl. 2: f. 2531; ed. 2. 2: f. 2990; N. Mex. Agr. Exp. Sta. Bull. 78: pl. [3]; Cact. Journ. 1: 167; Gard. Chron. 50: 340, the last two as *Opuntia missouriensis;* Pac. R. Rep. 4: pl. 14, f. 8 to 10; pl. 23, f. 18, the last two as *Opuntia missouriensis albispina;* Pac. R. Rep. 4: pl. 14, f. 5 to 7; pl. 24, f. 1, 2, the last two as *Opuntia missouriensis microsperma;* Pac. R. Rep. 4: pl. 14, f. 4; pl. 23, f. 17, these last two as *Opuntia missouriensis platycarpa;* Pac. R. Rep. 4: pl. 14, f. 1 to 3; pl. 23, f. 16, these last two as *Opuntia missouriensis rufispina;* Monatsschr. Kakteenk. 9: 148, this last as *Opuntia schweriniana*.

Plate XXXV, figure 3, represents a flowering joint of the plant collected by Dr. Rose in western Kansas in 1912. Figure 247 represents joints of the plant from Colorado, photographed by T. W. Smillie.

Series 24. STENOPETALAE.

This is an anomalous group in *Opuntia*, since the flowers are diœcious and the petals are linear and more or less erect. It contains three species which are very different in habit and color of spines, but which were all united into a single species by Professor Schumann. Dr. Engelmann was so much impressed by the peculiar structure of the flowers of this group that he proposed for it a new subgenus, *Stenopuntia*.

KEY TO SPECIES.

Spines dark; plants low, prostrate ..... 225. *O. stenopetala*
Spines white; plants erect.
  Joints narrow; spines acicular ..... 226. *O. glaucescens*
  Joints broader; spines stouter ..... 227. *O. grandis*

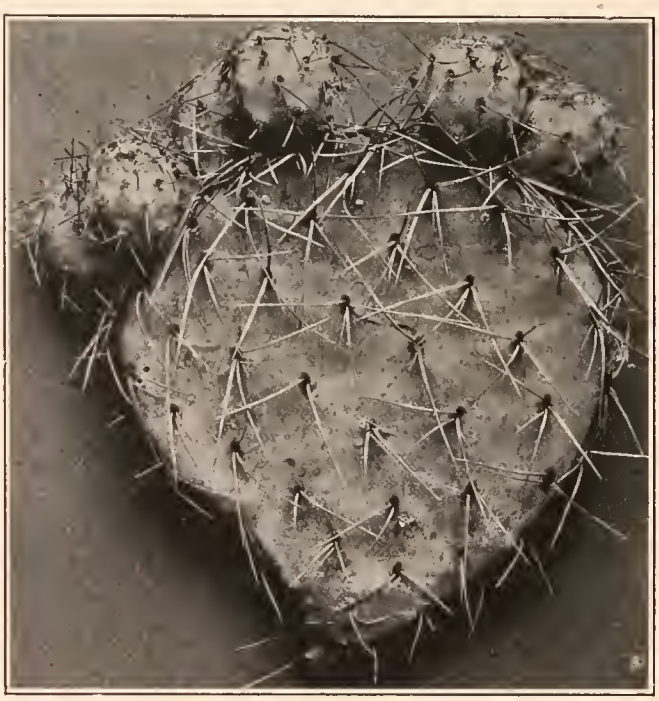


FIG. 248.—Opuntia stenopetala.

225. Opuntia stenopetala Engelmann, Proc. Amer. Acad. 3: 289. 1856.

Low bushy plant, often forming thickets, the main branches procumbent and resting on the edges of the joints; joints obovate to orbicular, 1 to 2 dm. long, grayish green, but often more or less

purplish, very spiny; areoles often remote, 1 to 3 cm. apart, the lower ones often without spines, bearing white wool when young; leaves only on young joints, spreading, dark red, about 2 mm. long; spines usually reddish brown to black, but sometimes becoming pale, usually 2 to 4, the longest ones 5 cm. long, the larger ones somewhat flattened; glochids very abundant on young joints, brown; flowers dioecious, small, including the ovary only 3 cm. long; petals orange-red, very narrow, 10 to 12 mm. long, with long acuminate tips; filaments short; style very thick in the middle, the male flowers with an abortive, pointed style, but female flowers with 8 or 9 yellow stigma-lobes on style; ovary leafy, the upper leaves similar to the sepals; fruit globular, 3 cm. in diameter, acid, naked or spiny; seeds small, smooth, 3 mm. in diameter, with broad, rounded margins.

Type locality: On battlefield of Buena Vista, south of Saltillo, Mexico.

Distribution: In States of Coahuila to Querétaro and Hidalgo, central Mexico.

Referred by Schumann to *O. glaucescens*, but surely a distinct species, as indicated by Berger (Monatsschr. Kakteenk. 14: 171. 1904).

Although in its habit this *Opuntia* is much like many others, its flowers are unique, the petals being very narrow and erect; it is a very beautiful plant, and at flowering time is covered with numerous, small, beautiful flowers. Dr. Griffiths states that it is one of the most valuable ornamental opuntias, and that it is hardy in southern California.

Illustrations: Cact. Mex. Bound. pl. 66; Monatsschr. Kakteenk. 14: 172. f. 1.

Figure 248 is from a photograph of a fruiting joint of a specimen collected by Dr. Edward Palmer near Saltillo, Mexico, in 1905; figure 249 is copied from the illustration first above cited.

FIG. 249.—Opuntia stenopetala.

226. Opuntia glaucescens Salm-Dyck, Hort. Dyck. 362. 1834.

Probably erect; joints erect, oblong-obovate, 12 to 15 cm. long, 5 cm. broad, sometimes narrowed at both ends, pale green, glaucous, usually purplish around the areoles; leaves small, reddish when young; areoles filled with gray wool; spines 1 to 4, elongated, acicular, white, 2.5 cm. long; glochids brownish to rose-colored.

Type locality: In Mexico.

Distribution: Mexico, but range unknown.

The flowers were not known when the species was first described and we do not know that they have since been observed. It has long been in cultivation, but specimens grown under glass at New York have not flowered.

227. Opuntia grandis Pfeiffer, Enum. Cact. 155. 1837.

More or less erect, 6 dm. high or more; joints oblong, 12 to 18 cm. long, erect, when young reddish, glaucous; leaves rose-colored; spines few, white; flowers small, a little open, 2 cm. broad; petals few, narrowly lanceolate, 12 mm. long; filaments reddish; style shorter than the stamens, rose-colored; stigma-lobes 2 or 3, acute.

Type locality: In Mexico.

Distribution: Mexico, but range unknown.

Referred by Schumann to *O. glaucescens*, but doubtless distinct, as indicated by Berger.

Illustration: Monatsschr. Kakteenk. 14: 172. f. 2.

Series 25. PALMADORAE.

An erect plant with narrow flat joints, small, brick-red flowers, and apparently erect stamens; the epidermis densely papillose-tuberculate when dry. The flowers suggest those of the *Spinosissimae*, but otherwise the plant is quite different. The series consists of a single species, from the catinga region of eastern Brazil.

228. Opuntia palmadora sp. nov.

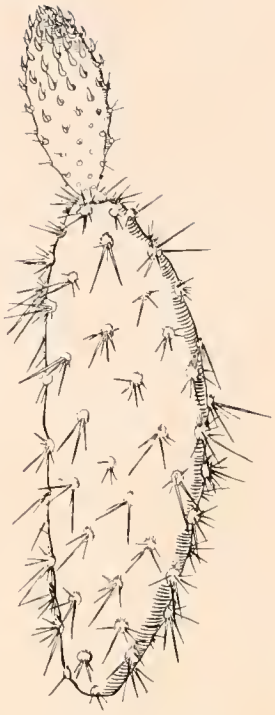


FIG. 250.—O. palmadora.

Plant often 3 meters high, sometimes even 5, but often low; trunk sometimes 9 cm. in diameter, sometimes with brown, smooth bark, but usually very spiny; branches numerous, usually erect, at times forming a compact, almost globular top, at other times quite open; joints unusually thin and narrow, 1 to 1.5 dm. long, generally erect, very spiny; leaves subulate, minute, 3 to 4 mm. long, green with reddish tips, found only on very young joints; areoles filled with white wool; spines usually 1 to 4, sometimes 6, from an areole, all yellow at first, in age white, the largest one porrect, 3 cm. long; petals erect or only slightly spreading, brick-red in color; stamens short, erect; filaments orange-colored; style cream-colored; stigma-lobes white; ovary broadly turbinate, 2 cm. long, tuberculate; fruit small.

Collected by Rose and Russell at Barrinha, Bahia, Brazil, June 7, 8, 1915 (No. 19787).

This plant is common in the semiarid parts of Bahia, where it is known as palmadora or palmatoria. Johnston and Tryon describe it briefly without giving it a name in their Report of the Prickly-Pear Travelling Commission, 104. 1914.

Figure 250 represents joints of the type plant; figure 251 is from a photograph of the wild plant from which the above was taken.

Series 26. SPINOSISSIMAE.

Erect species, mostly tall, with terete, continuous, unjointed, usually densely spiny trunks, the ultimate branches spreading or divaricate, flat, usually elongated, spiny or sometimes unarmed; flowers small, yellow, orange or red, or changing from yellow to red; fruit fleshy. We recognize seven species, all natives of the West Indies. The series represents the genus *Consolea* of Lemaire.

FIG. 251.—Opuntia palmadora. A thicket in Bahia, Brazil.

FIG. 252.—Opuntia nashii.

KEY TO SPECIES.

Areoles of the joints distant, 2 to 4 cm. apart.
- Spines few, 3 cm. long or less, or none.
  - Areoles elevated, bearing 2 to 5 grayish spines 3 to 6 cm. long ..... 229. *O. nashii*
  - Areoles scarcely elevated, spineless or with 1 to 4 weak yellow spines 1 to 2 cm. long ... 230. *O. bahamana*
- Spines, when present, many, the older up to 12 cm. long ..... 231. *O. macracantha*

Areoles of the joints closer together, 1 to 1.5 cm. apart.
- Spines of the trunk-areoles, or most of them, deflexed.
  - Young spines straw-colored or whitish; plant up to 5 m. tall ..... 232. *O. spinosissima*
  - Young spines purple; plant 6 dm. high or less ..... 233. *O. millspaughii*
- Spines of the trunk-areoles, when present, spreading.
  - Joints distinctly reticulate-areolate, light green; ovary prominently tuberculate ..... 234. *O. moniliformis*
  - Joints indistinctly reticulate-areolate, mostly dark green or reddish; ovary low-tuberculate 235. *O. rubescens*

229. **Opuntia nashii** Britton, Bull. N. Y. Bot. Gard. 3: 446. 1905.

Tree-like, or sometimes bushy, dull green; main axis round, 1 to 4 meters high, 5 to 12 cm. in diameter, spiny; branches flat or becoming round below, the principal ones continuous, 1 meter long or more, 6 cm. wide or less, crenate, blunt; lateral branches opposite or alternate, oblong to linear-oblong, often 3 dm. long, and 8 cm. wide, only about 6 mm. thick, blunt, crenate; areoles 1 to 3 cm. apart, slightly elevated; spines mostly 5 at each areole (2 to 5), divergent, slender, straight, light gray, pungent, the longer 3 to 6 cm. long; glochids very small, brownish; ovary 3 cm. long, 1.5 cm. thick, somewhat clavate, tubercled, the tubercles bearing areoles and spines similar to those of the joints, but the spines somewhat shorter; flowers 1.5 cm. broad when expanded, red; petals broadly oval to obovate, blunt, about 8 mm. long, much longer than the stamens.

Type locality: Inagua, Bahamas.

Distribution: Andros, Crooked Island, Fortune Island, Atwood Cay, Caicos Islands, Turks Islands, Ship Channel Cay, and Inagua, Bahamas.

Figure 252 is from a photograph of a plant at Matthew Town, Inagua, Bahamas, taken by George V. Nash, in 1904; figure 253 is from a photograph of a plant from the same place in the collection of the New York Botanical Garden.

Fig. 253.—Opuntia nashii.

230. **Opuntia bahamana** sp. nov.

Branched from near the base, bushy, about 1.5 m. high; joints oblong to lanceolate, flat, and thin, 1 to 5 dm. long, 4 to 10 cm. wide, dull green, obtuse, scarcely undulate; leaves red, subulate, 3 cm. long; areoles 1.5 to 3 cm. apart, scarcely elevated, about 2 mm. in diameter, spineless, or bearing 1 to 4 acicular yellow spines 2 cm. long or less when young; glochids few and short; flower about 6 cm. broad; petals obovate, rose-tinted below, yellowish rose above; sepals dark rose, whitish margined.

Distribution: Rocky slopes, The Bright, Cat Island, Bahamas, collected by N. L. Britton and C. F. Millspaugh, March 1907, No. 5794.

This plant was tentatively referred by us (Smiths. Misc. Coll. 50: 525. 1908) to *Opuntia lanceolata* Haworth. It has been grown under glass at New York ever since, but does not respond well to greenhouse conditions.

It is here included in the series *Spinosissimae*, but with hesitation, its bushy habit and larger flowers being anomalous in this group.

Figure 254 represents a joint of the type specimen above cited; figure 255 is copied from a sketch of a flower made by Dr. Millspaugh on Cat Island, when the plant was discovered.

231. **Opuntia macracantha** Grisebach, Cat. Pl. Cub. 116. 1866.

Erect, the trunk up to 15 cm. in diameter, its areoles 1 to 2 cm. broad, bearing many brownish glochids and several divergent spines 15 cm. long or less; upper portion of the trunk, and the ultimate, oblong, or oblong-ovate, spreading branches flat, green, faintly shining, the areoles 2 to 3 cm. apart, scarcely elevated, the numerous glochids brown; spines 1 to 4, up to 15 cm. long, nearly white, stout, subulate, or wanting; flowers often numerous; ovary 2.5 to 3 cm. long, densely beset with glochid-bearing areoles; petals orange-yellow, 1 to 1.3 cm. long.

Type locality: Cuba, in maritime depressions.

Distribution: Southern coast of eastern Cuba and adjacent plains.

Specimens of the plant were erroneously referred by Grisebach to *O. triacantha.* It is a picturesque feature of the flora of its native habitat.

Figure 256 is from a photograph of the plant on the United States Naval Station, Guantánamo Bay, Cuba, taken by Marshall A. Howe in 1909; figure 257 is from a photograph of a plant from the same place, grown at the New York Botanical Garden.

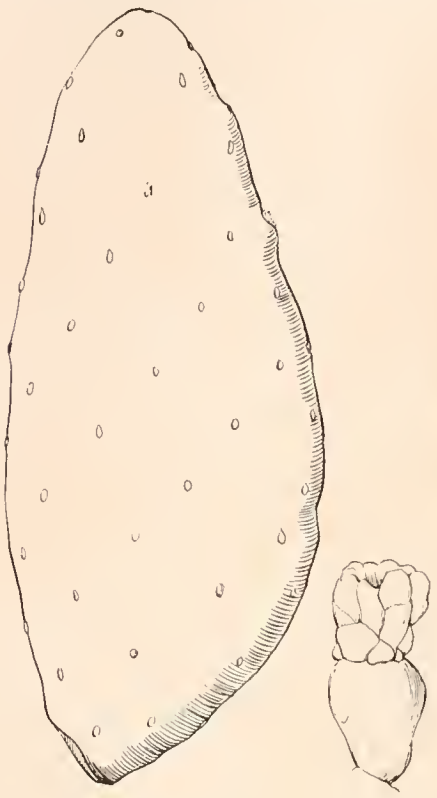


FIG. 254.—Joint of Opuntia bahamana.

FIG. 255.—Flower of the same.

FIG. 256.—Opuntia macracantha.

232. **Opuntia spinosissima** Miller, Gard. Dict. ed. 8. No. 8. 1768.

Cactus spinosissimus Martyn, Cat. Hort. Cant. 88. 1771.
Consolea spinosissima Lemaire, Rev. Hort. 1862: 174. 1862.

Erect, up to 5 m. high, the trunk sometimes 8 cm. in diameter, densely clothed with areoles bearing many long brownish glochids and acicular, deflexed or spreading spines up to 8 cm. long; ultimate branches flat, dull green, narrowly oblong, 2 to 4 times as long as wide, their areoles 1 to 1.5 cm. apart, slightly or not at all elevated, bearing brown glochids and 1 to 3 acicular, straw-colored or whitish spines 8 cm. long or less, or spineless; ovary 3 to 8 cm. long, often flattened, its areoles bearing short glochids; petals about 1 cm. long, oblong-obovate, rounded at the apex, at first yellow, turning dull red.

Type locality: Jamaica.

Distribution: Southern coast of Jamaica.

Plate XXXVI, from a painting by Miss H. A. Wood at Hope Gardens, Jamaica, sent by William Harris in 1907. Figure 258 is from a photograph of a plant obtained by Professor John F. Cowell in Jamaica and sent from the Buffalo Botanical Garden to the New York Botanical Garden in 1904.

233. **Opuntia millspaughii** Britton, Smiths. Misc. Coll. 50: 513. 1908.

Trunk terete, 7 cm. thick at base, 5 cm. thick at top, 6 dm. high or less, branching at the summit, the branches divaricate-ascending, narrowly oblong, much compressed, 40 cm. long or less, 5 to

H. A. Wood del.

Opuntia spinosissima.

1. Flowering joint.
2, 3. Single flowers.
4, 5. Longitudinal section of flower.
6. Cross-section of ovary.
7. Style.

10 cm. wide, 1 to 1.5 cm. thick, light green; branchlets obliquely lanceolate, obtuse, as wide as the branches, but shorter, 1 cm. thick or less, floriferous at and near the apex; areoles of the older branches pitted, about 1 cm. apart, those of very young shoots slightly elevated, the glochids very short, yellowish brown; spines of the trunk 15 cm. long or less, very numerous and densely clothing the trunk, very slender, gray, mostly strongly reflexed, pungent, those of the branches and branchlets restricted to the areoles on their edges, shorter than those of the trunk but similar, purple when

FIG. 257.—Opuntia macracantha.

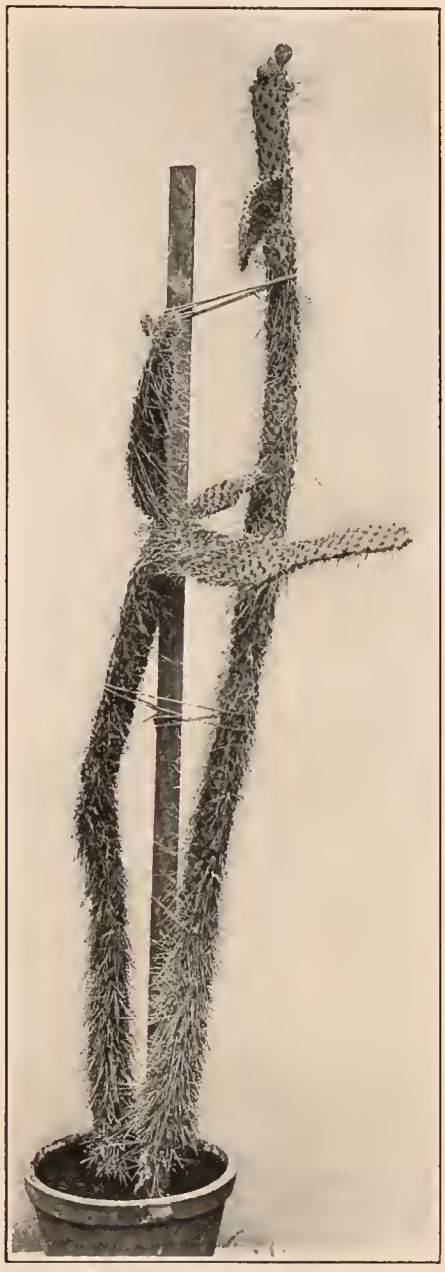


FIG. 258.—Opuntia spinosissima.

young, those of the fruit yellowish gray, 2 cm. long or less; flowers cupulate, crimson-lake, 1 cm. wide; sepals fleshy, ovate, acute, 4 mm. long and wide; petals erect-ascending, obovate, mucronulate, about 4 mm. wide; stamens half as long as the corolla; style about as long as the corolla; stigma-lobes oblong, yellowish crimson; fruit compressed-obovoid, 2 cm. long, 1.5 cm. thick, bearing one or two spines at most of the areoles.

Type locality: Rock Sound, Eleuthera Island, Bahamas.

Distribution: Eleuthera and Great Ragged Island, Bahamas; Cayo Paredón Grande, Cuba.

Figure 259 is from a photograph of the type plant taken at the type locality by Dr. C. F. Millspaugh, February 22, 1907.

234. Opuntia moniliformis (Linnaeus) Haworth in Steudel, Nom. ed. 2. **2**: 221. 1841.

Cactus moniliformis Linnaeus, Sp. Pl. 468. 1753.
Cactus ferox Willdenow, Enum. Pl. Suppl. 35. 1813.
Opuntia ferox Haworth, Suppl. Pl. Succ. 82. 1819.
Cereus moniliformis De Candolle, Prodr. **3**: 470. 1828.
Consolea ferox Lemaire, Rev. Hort. **1862**: 174. 1862.
Opuntia microcarpa Schumann, Gesamtb. Kakteen 714. 1898. Not Engelmann. 1848.
Nopalea moniliformis Schumann, Gesamtb. Kakteen 750. 1898.
Opuntia testudinis-crus Weber in Gosselin, Bull. Mus. Hist. Nat. Paris **10**: 389. 1904.
Opuntia haitiensis Britton, Smiths. Misc. Coll. **50**: 513. 1908.

Trunk somewhat flattened above, 3 to 4 m. high, branching at the top, densely armed with acicular, yellowish or gray spines 12 cm. long or less, their bases clothed with yellowish-white wool 1 to 2 cm. long; joints obliquely linear-oblong to obovate, 1 to 3 dm. long, 13 cm. wide or less, about 1 cm. thick, obtuse, distinctly areolate-reticulate, the areoles somewhat elevated, 1 to 1.5 cm. apart, those of young joints bearing near the edges 3 to 6 acicular spines 1 to 2.5 cm. long, those on the sides of the young joints often spineless or with 1 to 3 yellowish

FIG. 259.—Opuntia millspaughii.

FIG. 260.—Opuntia moniliformis on the plain at Azua, Santo Domingo.

spines, and with small tufts of grayish wool; older joints bearing at all areoles 5 to 8 yellowish spines similar to those of the trunk, and brown glochids 6 or 8 mm. long; flowers about 2.5 cm. broad; sepals as broad as long, or broader, apiculate; petals yellow to orange, ovate, apiculate, spreading; stamens much shorter than the petals; ovary cylindric to obovoid-cylindric, terete or nearly so, 4 to 5 cm. long, its distinctly elevated areoles close together, only 5 or 6 mm. apart, bearing brown glochids 2 mm. long, but no spines; fruit oblong-obovoid, about 6 cm. long.

Type locality: Hispaniola.

Distribution: Hispaniola; Desecheo Island, Porto Rico.

The ovaries, fruits and small joints of this species are readily detached and on falling to the ground strike root and proliferate, forming masses of subglobose or turgid joints entirely different in aspect from the fully developed, tree-like plant. It was on this stage of the organism that the *Cactus moniliformis* of Linnaeus, founded on Plumier's conventionalized plate above cited, was based; this illustration is, however, apparently erroneous in showing the style as long-exserted.

The names *Opuntia dolabriformis* and *Opuntia cruciata* were published by Pfeiffer (Enum. Cact. 167. 1837) as synonyms of *O. ferox*. Some of the joints and, perhaps, some whole plants of this species are nearly or quite spineless.

Illustrations: Descourtilz, Fl. Med. Antill. ed. 2. 7: pl. 514, as Cactier moniliforme; Plumier, Pl. Amer. ed. Burmann. pl. 198, as *Cactus*, etc.

FIG. 261.—Opuntia moniliformis. The same species as 260, but showing a different mode of growth.

FIG. 262.—Opuntia moniliformis. ×0.66.

Figure 260 is from a photograph of a plant at Azua, Santo Domingo, taken by Paul G. Russell in 1913; figure 261 is from a photograph taken by Frank E. Lutz on Desecheo Island, Mona Passage, Porto Rico, in 1914, showing a mass of proliferating sterile ovaries or small joints below and the mature stage of the plant above; figure 262 represents several of the small joints of the Desecheo plant.

235. **Opuntia rubescens** Salm-Dyck in De Candolle, Prodr. 3: 474. 1828.

Opuntia catacantha Link and Otto in Pfeiffer, Enum. Cact. 166. 1837.
Consolea rubescens Lemaire, Rev. Hort. 1862: 174. 1862.
Consolea catacantha Lemaire, Rev. Hort. 1862: 174. 1862.
Opuntia guanicana Schumann in Gürke, Monatsschr. Kakteenk. 18: 180. 1908.

Trunk erect, nearly cylindric below, flattened above, 3 to 6 meters high, sometimes 1.5 dm. in diameter, branching above, its areoles bearing several or many acicular spines up to 8 cm. long or more, or spineless; ultimate joints thin and flat, mostly dark green or reddish green, not reticulate-areolate except when young, oblong to oblong-obovate, 2.5 dm. long or less, mostly 2 to 4 times as long as wide, the terminal ones often much smaller; areoles 1 to 1.5 cm. apart, bearing several acicular nearly white spines 1 to 6 cm. long, or spineless; flowers yellow, orange or red, about 2 cm. broad; ovary long-tuberculate, 4 to 5 cm. long, about 1.5 cm. in diameter; petals obovate, apiculate; stamens about half as long as the petals; fruit reddish, obovoid or subglobose, 5 to 8 cm. in diameter, spiny or spineless; seeds suborbicular, 6 to 8 mm. in diameter.

FIGS. 263, 264.—Opuntia rubescens.

Type locality: Cited as Brazil, but erroneously.

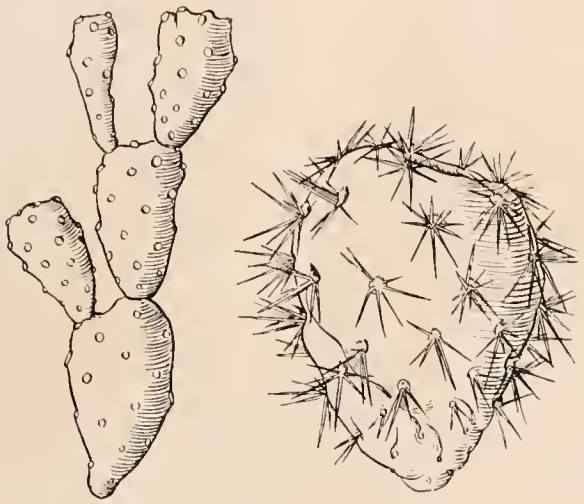
Distribution: Mona and Porto Rico to Tortola, St. Croix, and Guadeloupe.

Culebra, St. Thomas, St. Jan, and Montserrat plants agree with the description of *Opuntia rubescens*, which clearly belongs with the *Spinosissimae* (*Cruciformes*), as pointed out by Berger, rather than with the South American series *Inarmatae*, where it was placed by Schumann; it is a spineless state of *O. catacantha*, as was conclusively proven by us through field observations in the Virgin Islands, and greenhouse plants of *O. rubescens* develop spines.

Both the spiny and spineless races exhibit remarkable proliferation of the ovaries, these often forming chains of several joints while attached to the plant; these, falling to the ground, strike root and form many small, flattened joints 2 to 4 cm. long, as in *Opuntia moniliformis*, to which this species is otherwise closely related.

Illustration: Journ. N. Y. Bot. Gard. 7: f. 6, as *Opuntia*.

Figure 263 is from a photograph of the plant taken by Professor John F. Cowell at Guanica, Porto Rico, in 1915; figure 264 is from a photograph taken by Professor Cowell at the same time and place, showing in the foreground a mass of young plants arisen from proliferating joints, and a mature plant behind; figure 265 represents proliferating joints of a plant grown at Nisky, St. Thomas, collected by Dr. Britton and Dr. Rose in 1913; figure 266 represents a fruit, collected by Dr. Britton and Dr. Shafer on Buck Island, St. Thomas, in 1913.



FIGS. 265, 266.—Opuntia rubescens. ×0.66.

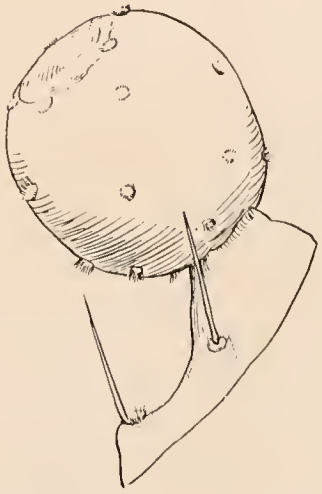


FIG. 267.—Opuntia brasiliensis. ×0.75.

Series 27. BRASILIENSES.

This series represents one of the five subgenera described by Dr. Schumann, which he called *Brasiliopuntia*. It perhaps should be recognized as a distinct genus. We recognize three species in the series, which may be races of a single one, characterized by an erect cylindric trunk with cylindric, horizontal branches terminating in a series of flattened, thin, leaf-like branches. The leaves are small and caducous. The spines are few on the young growth, but large clusters are developed on the old stem and trunk. The flowers are small, the fruit is juicy, and the seeds are large and covered with a dense mass of wool. Unlike most species of *Opuntia*, these grow in the moist tropical forests, forming tall, slender, tree-like plants.

KEY TO SPECIES.

Fruit globular, yellow ..... 236. *O. brasiliensis*
Fruit clavate to oblong, red.
  Fruit oblong, 3 to 4 cm. long ..... 237. *O. bahiensis*
  Fruit clavate, 5 cm. long ..... 238. *O. argentina*

236. Opuntia brasiliensis (Willdenow) Haworth, Suppl. Pl. Succ. 79. 1819.

Cactus brasiliensis Willdenow, Enum. Pl. Suppl. 33. 1813.
Cactus paradoxus Hornemann, Hort. Hafn. 2: 443. 1815.
Cactus arboreus Vellozo, Fl. Flum. 207. 1825.
Opuntia arborea Steudel, Nom. ed. 2. 2: 220. 1841.
Cereus paradoxus Steudel, Nom. ed. 2. 1: 335. 1841.

Becoming 4 meters high, with a cylindric woody trunk and a small rounded top; old trunk either naked or spiny; branches dimorphic, the lateral ones horizontal, terete; the terminal joints flat and leaf-like, many of these in time dropping off; flowers 5 to 5.5 cm. long; petals yellow, oblong, obtuse; filaments very short; fruit yellow, globular, 3 to 4 cm. in diameter, with a low or nearly truncate umbilicus, bearing large areoles; seed usually one, very woolly, 10 mm. broad.

Type locality: Near Rio de Janeiro, Brazil.

Distribution: Southern Brazil, Paraguay, Argentina, and central Bolivia. Naturalized in southern Florida.

A number of varieties of this species appear in literature, of which we may mention the following: *minor* Pfeiffer (Enum. Cact. 169. 1837); *schomburgkii* Salm-Dyck (Cact. Hort. Dyck. 1849. 74. 1850); *spinosior* Salm-Dyck (Hort. Dyck. 184. 1834); *tenuifolia* Forbes (Hort. Tour Germ. 159. 1837); and *tenuior* Salm-Dyck (Hort. Dyck. 376. 1834).

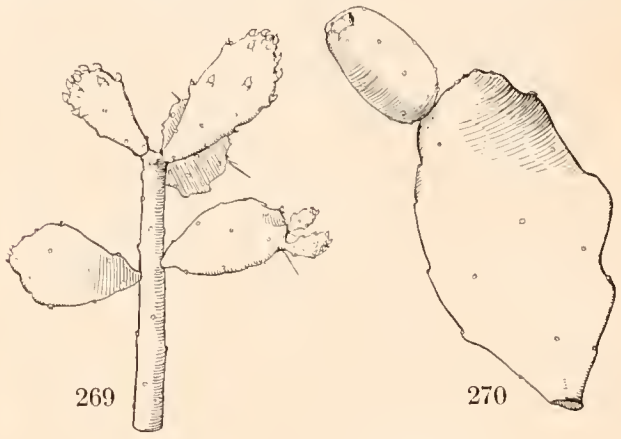
Dr. John H. Barnhart recently called our attention to a number of cactus names published by St. Hilaire which have been overlooked by later writers. One of these, *Cactus heterocladus* St. Hilaire (Voy. Rio de Janeiro and Minas Geraes 2: 103. 1830) seems to belong here, as the following free translation would indicate:

Fig. 268.—Opuntia brasiliensis.

"Another cactus, which I have already seen near Rio de Janeiro, raised its branches in the midst of tortuous lianas; its trunk, which grows more slender from the base to the summit, is covered with fascicles of spines arranged in a quincunx, and it shows various stages of verticillate, horizontal, rounded branches, to the number of seven in each whorl; these branches, like those of the spruce tree, grow shorter toward the summit of the plant, and they bear secondary branches, flattened and oval-oblong, which may in a certain sense be taken as leaves."

Illustrations: Curtis's Bot. Mag. 61: pl. 3293; Dept. Agr. N. S. W. Misc. Publ. 253: pl. [6]; Martius, Fl. Bras. 4[2]: pl. 61; Pfeiffer and Otto, Abbild. Beschr. Cact. 1: pl. 29; Schumann, Gesamtb. Kakteen f. 100; Vellozo, Fl. Flum. 5: pl. 28, this last as *Cactus arboreus*.

Plate xxx, figure 2, represents a flowering joint taken from a specimen in the New York Botanical



Figs. 269, 270.—Opuntia bahiensis. ×0.5.

Garden; figure 3 is from the same plant, showing terete and flat joints. Figure 267 represents a fruit collected by Dr. Rose near Iguaba Grande, Brazil, in 1915; figure 268 is from a photograph taken by Paul G. Russell in a public park in Bahia, Brazil.

237. Opuntia bahiensis sp. nov.

Trunk 3 to 15 meters high, cylindric, 20 to 25 cm. in diameter, tapering gradually upward; the center of trunk pithy, hollow in age, surrounded by an open woody cylinder; lateral joints terete, the terminal ones flat and thin, ovate to oblong; leaves small, 2 to 3 mm. long, turgid; spines on terminal joints, if present, 1 or 2, slender, red at first, then brown; spines on old trunk forming large clusters at all the areoles; flowers not seen; fruit deep red both within and without, oblong, 3 to 4 cm. long; its small areoles with brown glochids; seeds 1 to 5, mostly 1 or 2 in each fruit, very hairy, thick, 8 mm. broad.

Collected in the vicinity of Toca da Onca, Bahia, Brazil, by Rose and Russell, June 27 to 29, 1915 (No. 20068).

Figure 269 represents joints of the type plant above cited; figure 270 represents a joint with fruit; figure 271 is from a photograph of the type specimen.

FIG. 271.—Opuntia bahiensis. The tree to the left and somewhat in the foreground.

FIG. 272.—Opuntia ammophila.

238. Opuntia argentina Grisebach, Abh. Ges. Wiss. Göttingen 24: 140. 1879.

Opuntia hieronymi Grisebach, Abh. Ges. Wiss. Göttingen 24: 140. 1879.

Erect, 5 to 15 meters high, branching at the top, the lateral branches subverticillate, teretes terminal branches flat, 5 to 12 cm. long, 3 to 8 cm. broad; ovary 2 to 2.5 cm. long; petals elliptic to spatulate, 1.8 cm. long, 8 mm. broad, greenish yellow; filaments white; style white; stigma-lobe; yellowish green; ovary flattened, tuberculate, deeply umbilicate; fruit clavate, 5 cm. long, dull purplish violet, with wine-colored pulp; seeds lens-shaped, 5 to 6 mm. long, 2.5 to 3 mm. broad.

Type locality: Near San Andrés, Oran, Argentina.

Distribution: Northern Argentina.

This species was considered identical with *O. brasiliensis* by Schumann, but they separate on very good fruit characters.

Figure 274 is from a photograph of a flowering branch furnished by Dr. C. Spegazzini.

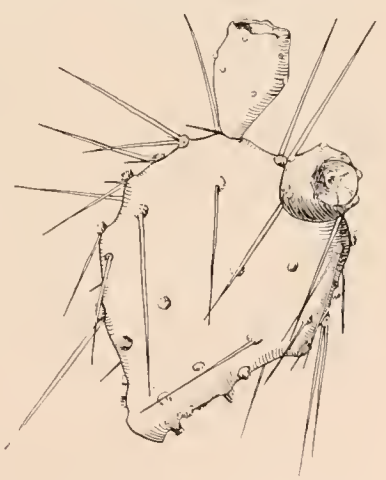


FIG. 273.—Opuntia ammophila.

Series 28. AMMOPHILAE.

One peculiar species, native of Florida, constitutes this series, characterized by a continuous erect subterete trunk, flat, spiny branches, and large, yellow flowers.

239. Opuntia ammophila Small, Journ. N. Y. Bot. Gard. 20: 29. 1919.

Plant erect, more or less branched throughout or ultimately with a stem 1 to 2 meters tall or more, becoming 2 to 2.5 dm. in diameter, bearing several spreading branches near the top, thus tree-like, tuberous at the base; joints various, those of the main stem elongate, ultimately fused on the ends and subcylindric, those of the branches typically obovate or cuneate, varying to elliptic or oval, thickish, 5 to 17 cm. long, becoming grayish green; leaves stout-subulate, 6 to 10 mm. long, green; areoles relatively

numerous, conspicuous on account of the densely crowded long bristles, especially on the older joints, the marginal ones, at least, armed; spines very slender, solitary or 2 together, reddish or red, at maturity gray, mostly 2 to 6 cm. long, nearly terete, scarcely spirally twisted; flowers several on a joint; sepals lanceolate, acute or slightly acuminate; buds sharply pointed; corolla bright yellow, 5 to 8 cm. wide; petals obovate, cuneate, notched, and prominently apiculate, 3 cm. long, scarcely erose; stigma-lobes cream-color; berries obovoid, 2 to 3 cm. long, more or less flushed with reddish purple, many-seeded; seeds about 4 mm. in diameter.

FIG. 274.—Opuntia argentina.

FIG. 275.—Opuntia chaffeyi. Photograph by Señor Don Teodoro Chairez.

Type locality: Fort Pierce, Florida.

Distribution: Inland sand-dunes (scrub), peninsular Florida.

The plant was first collected by Dr. Small near Fort Pierce, Florida, in 1917, and again studied by him in its more northern range west of St. George in 1918. He describes it as the most conspicuous native prickly pear of Florida, always viciously armed and with a characteristically unjointed trunk. In spite of its many slender spines, cattle browse upon it.

Illustration: Journ. N. Y. Bot. Gard. **20**: pl. 224.

Figure 272 is from a photograph of the plant taken by Dr. Small near Fort Pierce, Florida; figure 273 shows a fruiting joint of the type specimen.

Series 29. CHAFFEYANAE.

This series contains a single Mexican species, differing from all the other opuntias in having an annual stem which arises from a large, fleshy root or rootstock. The joints, which are elongated and nearly terete, resemble somewhat those of *O. leptocaulis*, but are more fleshy, while the flowers and fruit are like those of the platyopuntias.

240. Opuntia chaffeyi Britton and Rose, Contr. U. S. Nat. Herb. **16**: 241. 1913.

Perennial by a large, fleshy, deep-seated root or rootstock often 35 cm. long by 4 cm. in diameter; stems normally annual, 5 to 15 cm. long, sometimes in cultivated specimens 25 cm. long, much branched, often weak and prostrate; joints elongated, 3 to 5 cm. long, 6 to 7 mm. broad, slightly

FIG. 276.—Opuntia chaffeyi.

flattened, glabrous, pale bluish green or sometimes purplish; leaves minute, caducous; areoles small, circular, with white wool in the lower parts and brown wool in the upper parts; spines 1, rarely 2 or 3, acicular, 2 to 3 cm. long, whitish or pale yellow; glochids numerous, pale yellow; flower-buds, including ovary, 8 cm. long; flower opening at 10 a. m., closing at 2 p. m., 6 cm. broad; sepals few, small, ovate to oblong, greenish; petals few, 7 to 9, pale lemon-yellow, but slightly pinkish on the outside; filaments numerous, about 1 cm. long; style slender, extending beyond the stamens, about 22 mm. long, somewhat swollen at base; ovary deeply umbilicate, somewhat club-shaped, 4 to 5 cm. long, bearing flattened tubercles and large areoles filled with white wool; upper areoles on ovary bearing also white bristly spines; ovules numerous, borne in the upper third of the ovary; fruit and seeds still unknown.

Type locality: Hacienda de Cedros, near Mazapil, Zacatecas, Mexico.
Distribution: State of Zacatecas, Mexico.
Illustration: Contr. U. S. Nat. Herb. **16**: pl. 72.

Figure 275 is from a photograph of part of the original collection as grown by Dr. E. Chaffey, taken and contributed by Señor Don Teodoro Chairez, of Ciudad Lerdo, Mexico; figure 276 is from a photograph of the type showing the large root and the young shoot.

As stated in the original description, this is a remarkable *Opuntia*, being the only one known which has an annual stem. In cultivation, where the plant is grown under abnormal conditions, the stem persists for more than a year; but Dr. Chaffey assures us that in the desert, where the species grows naturally, the stem dies down to the ground in the dry season. We have had it in cultivation since 1910, but it does not do well, and is gradually dying out. It has not been found in flower in a wild state, but it flowered with Dr. Chaffey at Ciudad Lerdo, Durango, Mexico, in 1915. Dr. Chaffey, who has been studying this species for several years, has made a number of interesting observations; he states that the large base, which usually is found 15 to 20 cm. beneath the surface of the ground, when allowed to grow above the ground develops clusters of spines like those on the normal stems, and finds that the plant is easily started from cuttings which soon develop the normal, large, underground part. He further states that the desert turtle eats this plant. It is well known that the Galápagos turtles feed upon the native opuntias of those islands.

The native name of this plant is sacacil.

The following described Opuntias we have been unable to refer to any of the species otherwise mentioned in this work:

Opuntia bicolor Philippi, Linnaea 33: 83. 1864.
glaucophylla Wendland, Cat. Hort. Herrenh. 1835.
laevior Salm-Dyck, Cact. Hort. Dyck. 1844. 46. 1845.
longiglochia C. Z. Nelson, Galesburg Register. July 20, 1915.
lucida Hortus, Wiener Illustr. Gartenz. 14: 146. 1889.
prostrata spinosior Schumann, Gesamtb. Kakteen 723. 1898.
spinaurea Karwinsky in Salm-Dyck, Cact. Hort. Dyck. 1844. 46. 1845. As synonym for *O. pseudotuna elongata* Salm-Dyck.
tuberculata Haworth, Suppl. Pl. Succ. 80. 1819, first described as *Cactus tuberculatus* (Enum. Hort. Berol. Suppl. 34. 1813).

The following names of *Opuntia* are chiefly found in catalogues or in lists, or have been so briefly described that we have not been able to identify them, and it does not seem worth while even to cite the places where they first occur in literature:

Opuntia alpicola Schumann
americana Forbes
attulica Forbes
barbata K. Brandegee
barbata gracillima K. Brandegee
bernhardinii Hildmann
betancourt Murillo
calacantha
calacantha rubra
carolina Forbes
ciliosa Forbes
consoleana Todaro
consolei Haage and Schmidt
demorenia Forbes
demoriana Förster
deppei Wendland
dichotoma Forbes
eborina Förster
erecta Schumann
festiva Sencke
ficus-indica albispina Haage and Schmidt
flavispina Förster
hevernickii Hildmann
hitchenii Forbes
italica Tenore
joconostle Haage and Schmidt
jussieuii Haage
leucostata Forbes
macrophylla Haage and Schmidt
Opuntia missouriensis elongata Salm-Dyck
erythrostemma Haage and Schmidt
salmonea Haage and Schmidt
montana Sencke
morenoi Schumann
myriacantha Link and Otto. Not Weber
ottonis Salm-Dyck
pachyarthra flava Haage and Schmidt
pachyclada rosea Haage and Schmidt
spaethiana Haage and Schmidt
parote Forbes
piccolomini Hort.
platyclada Haworth
praecox Forbes
protracta Lemaire
elongata Salm-Dyck
pseudococcinellifer Bertoloni
pseudotuna Salm-Dyck
elongata Salm-Dyck
spinosior Salm-Dyck
pulverata Förster
reptans Karwinsky
salmii Forbes
schomburgkii Salm-Dyck
speciosa Steudel
spinuliflora Salm-Dyck
spinulosa Salm-Dyck
straminea Sencke
stricta spinulescens Salm-Dyck
subinermis Link

Opuntia clavata Philippi (Anal. Univ. Chile 41: 722. 1872), *O. ottonis* G. Don (Hist. Dichl. Pl. 3: 172. 1834), *O. phyllanthus* Miller (Gard. Dict. ed. 8. No. 9. 1768), *O. salicornioides* Sprengel (Pfeiffer, Enum. Cact. 141. 1837), and *O. spiniflora* Philippi (Linnaea 30: 211. 1859) are of the tribe *Cereeae*.

7. GRUSONIA F. Reichenbach in Schumann, Monatsschr. Kakteenk. 6: 177. 1896.

A low, much branched cactus, the branches terete, jointed, and ribbed; areoles borne on the tops of the ribs, very spiny, but all except the flowering ones without glochids, subtended by small deciduous leaves; corolla rotate, yellow; fruit baccate.

This was first described as a *Cereus* from specimens collected by Mrs. Anna B. Nickels in 1895, then as a new genus *Grusonia*, and lastly as an *Opuntia*. It clearly is not *Cereus*, but when growing might easily be mistaken by its habit for *Echinocereus*. The leaves, glochids, flowers, and fruit are those of *Opuntia*, but its ribbed stem is unlike that of any known species of that genus.

1. Grusonia bradtiana (Coulter).

Cereus bradtianus Coulter, Contr. U. S. Nat. Herb. 3: 406. 1896 (April).
Grusonia cereiformis F. Reichenbach in Schumann, Monatsschr. Kakteenk. 6: 177. 1896 (December).
Opuntia bradtiana K. Brandegee, Erythea 5: 121. 1897.
Opuntia cereiformis Weber, Dict. Hort. Bois 897. 1898.

Forming dense, often impenetrable thickets 2 meters high or less, very spiny; stems light green, 4 to 7 cm. thick, with 8 to 10 low, longitudinal, somewhat tuberculate ribs; areoles 1 to 1.5 cm. apart, 3 to 5 mm. in diameter; leaves linear, fleshy, green, 8 mm. long, early deciduous; spines 15 to 25, yellowish brown when young, soon becoming white, acicular, terete or slightly compressed, 1 to 3 cm. long, not sheathed, some of the longer ones reflexed; wool white, turning brown, early disappearing; corolla rotate, opening in bright sunlight, 3 to 4 cm. broad; sepals ovate, acute, fleshy; petals bright yellow, spatulate, fringed; filaments brownish yellow; stigma-lobes 8, yellow; areoles of the ovary with long, yellow, weak spines, white wool, and yellow glochids; berry (according to Schumann) ellipsoid, deeply umbilicate; seeds not seen.

Type locality: Plains of Coahuila, Mexico.
Distribution: Coahuila, Mexico.

This species first appeared in print in the catalogue of Johannes Nicolai under the name of *Grusonia cereiformis*, but we are informed that there was no description and therefore it was not technically published. The same name next appears in the Monatsschrift für Kakteenkunde for 1894. Here Dr. Schumann wrote a long article about the name, especially condemning the loose manner in vogue of publishing new names without descriptions, but giving no characters of the plant, and as a matter of fact he did not then know it. Two months later this name again appears in this same publication, but without description. Two years later Dr. Schumann records seeing this plant and describes it briefly, although he does not approve of the name *Grusonia*. If the name is to be considered published, it should not date earlier than this (December 1896), although Dalla Torre and Harms accept the date of 1894. In 1898 Weber transferred the name to *Opuntia*, publishing it as *Opuntia cereiformis;* in the meantime Coulter (in 1896) published the name *Cereus bradtianus* for the plant and Mrs. Brandegee (in 1897) transferred it to *Opuntia*, calling it *Opuntia bradtiana*.

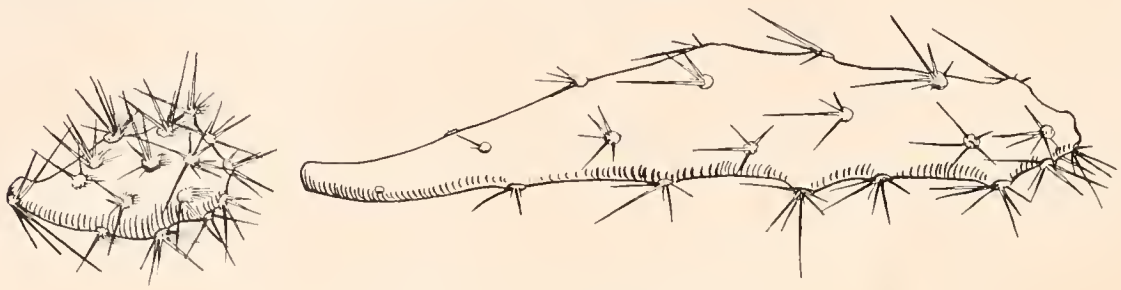
Illustrations: Monatsschr. Kakteenk. 21: 121, as *Opuntia bradtiana;* Schumann, Gesamtb. Kakteen f. 101, as *Opuntia cereiformis*.

Plate XXXIII, figure 4, represents a joint of the plant collected by C. A. Purpus at Cerro de Cypriano, near Morano, Mexico, in 1910.

APPENDIX.

3 *a*. **Nopalea gaumeri** sp. nov. (See page 37, *ante*.)

About 3 meters high, much branched; joints small, linear-oblong or oblong-oblanceolate, 6 to 12 cm. long, 2 to 3 cm. broad, rather thin; areoles small, 1 to 2 cm. apart; spines very unequal, 5 to 20 mm. long, acicular, 4 to 12, yellowish when young; flower small, including ovary and stamens about 4 cm. long; sepals ovate, acute; petals oblong, 12 mm. long; stamens long-exserted; style longer than the stamens; stigma-lobes 6, greenish; fruit red, darker within, obovoid, 3 cm. long, its numerous areoles bearing spines and yellow glochids; umbilicus prominent, 1 cm. deep; seeds about 4 mm. broad, with a very narrow margin and a very thin testa.



FIGS. 277 and 278.— Nopalea gaumeri. ×0.8.

Collected by George F. Gaumer and sons near Sisal, Yucatan, March 1916 (No. 23250, type); also by Dr. Gaumer from Port Silam, 1895 (No. 647).

Dr. Gaumer's field note is as follows: "A coastal cactus, 10 feet high, much branched, small-jointed and of slight build, not of robust build like the interior species. It blooms from February to June. The birds are very fond of the fruit and consume it as fast as it ripens."

Figures 277 and 278 show joints of the type-specimen.

77 *a*. **Opuntia depauperata** sp. nov. (See page 101, *ante*.)

Plant 1 to 2 dm. high, with a flattened, much branched top; joints dark green, readily detached, terete or slightly flattened, 3 to 12 cm. long, 2 to 3 cm. thick, puberulent; spines on young joints 2 or 3, on old joints sometimes 6 at each areole, reddish to pale brown, acicular, 1 to 2.5 cm. long, nearly porrect; glochids tardily developing, conspicuous on old joints, yellow; ovary with a deep umbilicus.

FIG. 279.—Opuntia depauperata.

Collected by Dr. and Mrs. J. N. Rose north of the station of Zig Zag, along the railroad above Carácas, Venezuela, October 17, 1916 (No. 21751).

This little cactus is very inconspicuous and only a few specimens were observed. The station is near the top of the mountains which separate the valley, in which Carácas lies, from the sea. The region here is not so dry as it is farther down on the seaward side of the mountains, but there are several other species of cacti associated with it.

Figure 279 is from a photograph of type plant taken by Mrs. Rose; figure 280 shows a joint.

A plant, apparently of this relationship, was collected by Dr. H. H. Rusby in 1917 on granite rocks, narrows of Magdalena River, Colombia. The joints, however, are glabrous, only 2 to 3 cm. long, the young joints have numerous brown spines and the young areoles produce long white wool.

82*a*. **Opuntia pestifer** nom. nov. (See page 103, *ante*.)

Cactus nanus Humboldt, Bonpland, and Kunth, Nov. Gen. et Sp. 6: 68. 1823.
Cereus nanus De Candolle, Prodr. 3: 470. 1828.

Low and nearly prostrate but sometimes 2 dm. high, much branched; the joints very fragile, glabrous; young joints 2 to 5 cm. long, or when old up to 8 cm. long, nearly terete, 1 to 3 cm. in diameter, or when young flattened and 2 to 3 cm. broad, very spiny; spines 2 to 5 at each areole, acicular, brownish, 1 to 3 cm. long; glochids numerous, yellow; flowers and fruit unknown.

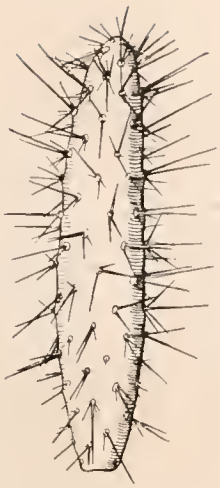


FIG. 280.—Opuntia depauperata. ×0.5.

Type locality: Near Sondorello and Guancabamba. In Humboldt's time these places were in southern Ecuador, but they are now in northern Peru.

Distribution: Northern Peru to central Ecuador.

Dr. Rose observed the plant in various places in Ecuador, usually at an altitude ranging from 1,000 to 1,500 meters. The following collections were made: at Huigra (No. 22306); at Sibambe (No. 22433); and west of San Pedro, Province of Loja (No. 23352).

This plant, although widely distributed and very common, has never been seen by botanists in flower or fruit. The joints, which come loose easily, are freely distributed by animals. It is so small that, growing half-hidden in the grass, it is easily overlooked but very annoying when one comes upon it unawares. Humboldt speaks of its being troublesome to men and dogs.

FIG. 281.—Opuntia pestifer. ×0.5.

Kunth who described it as *Cactus nanus* referred it with hesitancy to the Section *Cereus*. De Candolle transferred it from *Cactus* to *Cereus* placing it in a new subgenus *Opuntiacei* along with *C. moniliformis* (which we know now is an *Opuntia*) and *C. serpens*. He thought these might represent a genus between *Opuntia* and *Cereus*.

Schumann (Gesamtb. Kakteen 166) considered it an *Opuntia* but did not formally refer it to that genus.

This name should not be confused with *Opuntia nana* (Fl. Damatica 3: 143. 1852) which is *Opuntia opuntia*.

Figure 281 is from a photograph taken by George Rose at Sibambe, Ecuador, in 1918; figure 283 shows the joints of the same plant (Rose, No. 22433.)

96 *a*. **Opuntia discolor** sp. nov. (See page 109, *ante*.)

A low plant, forming small dense clumps; joints slender, 4 to 12 cm. long, 1.5 to 2.5 cm. in diameter, turgid, glabrous, dark green with dark purple blotches extending downward from the under margin of the areoles; spines 1 to 6, acicular, nearly porrect, somewhat variegated but mostly brown, 3 cm. long or less; glochids tardily developing but conspicuous on old branches, dark brown; flowers light yellow to orange-yellow, only 3 cm. long including the ovary; filaments white; style and stigma-lobes nearly white; fruit evidently very small, bright red.

FIG. 282.—Opuntia discolor.

This species is represented by two collections made by Dr. J. A. Shafer in 1917 which slightly differ from each other. They are No. 111, from sandy thickets, Santiago del Estaro, Argentina, February 23 (type), and No. 95, from gravelly hills near Tapia, Tucuman, February 9.

Apparently common in dry sandy thickets, growing best under bushes where it is least disturbed. The joints easily become detached, sticking readily to any disturbing object.

The species differs from *Opuntia retrorsa* in its more nearly terete joints and spreading spines.

Figure 282 is from a photograph of the type plant; figure 284 represents a joint of the plant from near Tapia, Tucuman.

FIG. 283.—Opuntia pestifer. ×0. 5.

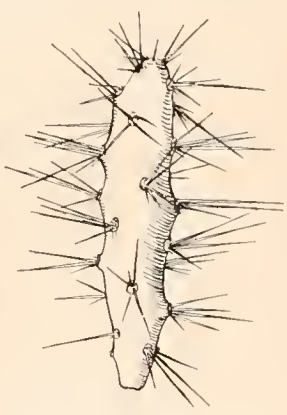


FIG. 284.—Opuntia discolor.

101 *a*. **Opuntia guatemalensis** sp. nov. (See page 113, *ante*.)

Low, spreading plant, resembling *O. decumbens*, but joints glabrous and shining; joints deep green, sometimes with dark blotches below the areoles; areoles small, filled with brown wool, subtended by small leaves; spines 1 to 3 at the areoles, terete, acicular, shining white with blackish tips when young, soon gray, mostly deflexed, somewhat spreading; flower-buds reddish; flowers much smaller than those of *O. decumbens;* petals lemon-yellow, 2.5 cm. long; stigma-lobes cream-colored.

Collected by Dr. Glover B. Wilcox in 1909 while acting as surgeon on a ship plying between Guatemala and San Francisco. Living specimens were sent directly to Washington and flowered there in April 1915.

Figure 285 represents a joint of the type specimen.

102 *a*. **Opuntia pennellii** sp. nov. (See page 115, *ante*.)

Plant low; joints 1 to 1.5 cm. long, obovate, turgid, bright green; spines 1 or 2 at each areole, nearly porrect, subulate, 3.5 cm. long or less, white with dark tips; glochids not very conspicuous, yellowish.

Collected near Magangue, coastal plain of Colombia, Department of Bolivar, at about 100 meters altitude, by Francis W. Pennell in 1918.

Figure 286 shows a joint of the type plant.

Here may belong herbarium specimens which we have seen from northern Colombia but with the material at hand it is impossible to determine them definitely. One of these was collected by William R. Maxon, April 10, 1906 (No. 3849) at Puerto Colombia. This plant is described as consisting of 3 to 6 joints, branching at the third or fourth joint, the joints all being in one place. The flowers are yellow and small, only about 4 cm. long, including the ovary. Another was collected by H. H. Smith near Bonda in 1898–1899 (No. 2728); this has joints very similar to those of Dr. Pennell's plant. It is said to be from 2 to 4 feet high.

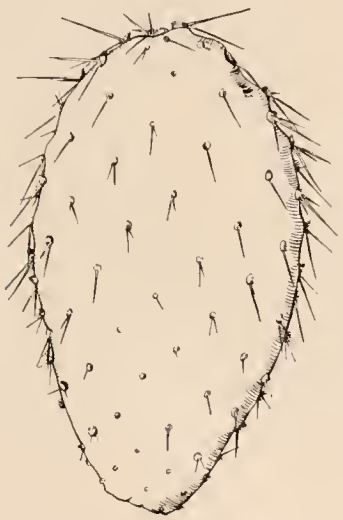


Fig. 285.—Opuntia guatemalensis. ×0.33.

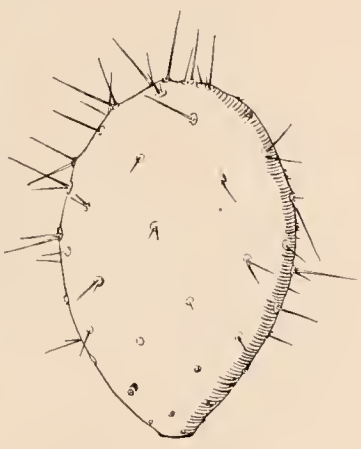


Fig. 286.—Opuntia pennellii. ×0.5.

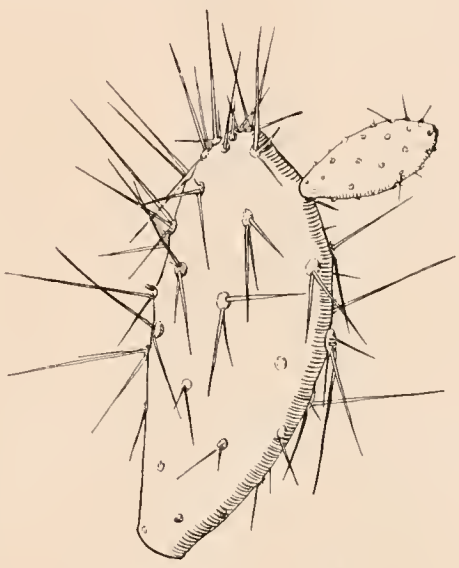


Fig. 287.—Opuntia caracasana. ×0.5.

103 *a*. **Opuntia caracasana** Salm-Dyck, Cact. Hort. Dyck. 1849. 238. 1850. (See page 116, *ante*.)

Stems low, bushy, 4 to 12 dm. high; joints oblong, 10 to 12.5 cm. long, turgid, pale green, "leaves squamiform, minute"; spines 2 to 4, unequal, 2.5 to 4 cm. long or less, pale yellow; flowers and fruit unknown.

Type locality: Near Carácas, Venezuela.

Distribution: Mountains about Carácas, Venezuela.

The type specimens were collected near Carácas by E. Otto, prior to 1849. Dr. Rose found the plant abundant above Carácas in 1916. It usually grows on exposed hillsides near the top of the divide which separates Carácas from the coast, and it was especially common along the railroad just below the little station of Zig Zag. Several other cacti are to be found in this neighborhood, among which are *O. elatior* and *O. depauperata*.

Figure 287 shows a joint of the plant collected by Dr. Rose above Carácas in 1916.

104 *a*. **Opuntia aequatorialis** sp. nov. (See page 116, *ante*.)

Bushy, much branched; 1 to 1.5 meters high; the branches spreading or recurved; joints narrowly oblong to obovate, 1.5 to 2 dm. long, 3 to 8 cm. broad, easily becoming detached; spines pale yellow, at first only 2 to 4 but more in age, subulate, 2.5 to 6 cm. long; flower-buds ovoid, acute, red; petals few, 8 to 10, orange-red, spatulate; filaments and style red; stigma-lobes cream-colored.

Collected in thickets on dry hills near Sibambe, Province of Chimborazo, Ecuador, by J. N. Rose and George Rose, August 29, 1918 (No. 22432).

The locality at which this species is found is semiarid and a number of other cacti are associated with it, among which is the little *O. pestifer*, described on a preceding page. *O. acquatorialis* was not so common as some of the other species and was usually found growing up through open-branched bushes and was in this way more or less protected.

Figure 288 is from a photograph of the type plant taken by George Rose; figure 289 shows one of its joints.

FIG. 288.—Opuntia aequatorialis.

116 *a*. **Opuntia lata** Small, Journ. N. Y. Bot. Gard. **20**: 26. 1919. (See page 126, *ante*.)

Plant prostrate, often radially branched, sometimes forming mats nearly a meter in width, the tip of the branches sometimes assurgent, with elongate cord-like roots; joints elliptic to narrowly obovate, often narrowly so, thick, 4 to 15 cm. long, deep green, sometimes glaucous, especially when young; leaves subulate, 6 to 11 mm. long, green or purple-tinged; areoles scattered, often conspicuous, sometimes very prominent and densely bristly, the marginal ones, at least, armed; spines slender, solitary or 2 together, pink, turning red or red-banded, at maturity gray or nearly white, nearly

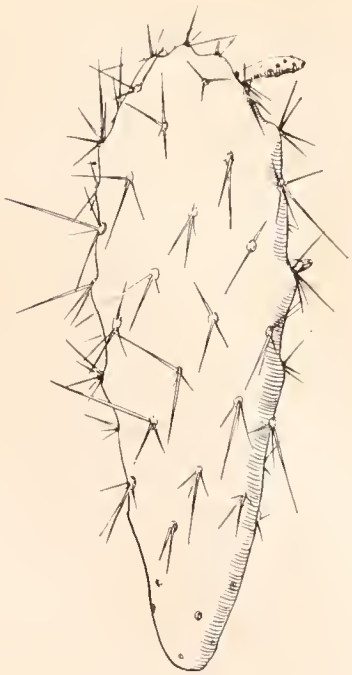
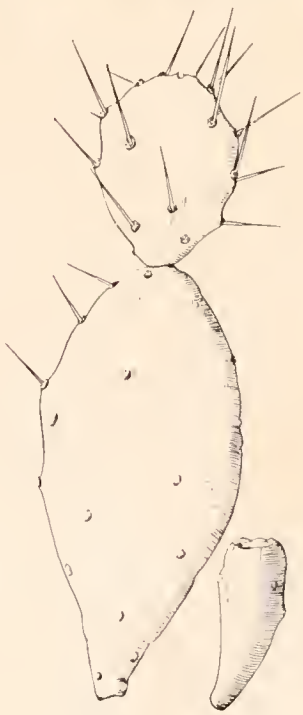
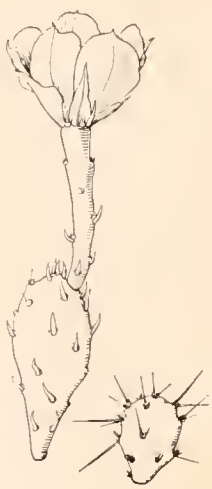


FIG. 289.—O. aequatorialis. ×0.4.



FIGS. 290 and 291.—O. lata. ×0.4.



FIGS. 292 and 293.—Opuntia macateei. ×0.4.

terete, slightly spirally twisted; flowers usually several on a joint, conspicuous; sepals subulate to lanceolate, acute; corolla yellow, 7 to 9 cm. wide; petals numerous, the inner ones broadly obovate to flabellate, erose at the broad minutely mucronate apex; berries clavate, 5 to 6.5 cm. long, red or reddish purple, many-seeded; seeds about 5 mm. in diameter.

Type locality: Twelve miles west of Gainesville, Florida.

Distribution: Pinelands, northern peninsular Florida.

It was first observed by Dr. Small near Gainesville, Florida, in 1917, and plants were taken to Mr. Charles Deering's cactus garden at Buena Vista, Miami, where it has grown luxuriantly, flowering and fruiting freely alongside of *O. pollardii* which it resembles in habit, but differs from in its long clavate berries and more numerous petals.

Figure 290 shows joints of the plant; figure 291 shows its fruit.

127 *a*. **Opuntia macateei** sp. nov. (See page 133, *ante*.)

Small prostrate plant; joints 2.5 to 6 cm. long, orbicular to obovate, glabrous, dull green, in age somewhat tuberculate; leaves linear, 10 mm. long or less, green; spines 1 to 3, brownish, the longer ones up to 2.5 cm. long; flowers, including the ovary, 8 to 10 cm. long, 7 to 8 cm. broad, yellow with a red center; ovary subcylindric, 5 to 6 cm. long, bearing conspicuous leaves, sometimes 12 mm. long.

Differs from related species by its small joints and slender, elongated, leafy ovaries. Collected by W. L. MacAtee at Rockport, Texas, December 28, 1910 (No. 1992).

Figures 292 and 293 represent the joints and flower of the plant.

159 *a*. **Opuntia soederstromiana** sp. nov. (See page 154, *ante*.)

Sometimes spreading and bushy, but usually erect, 6 to 10 dm. high, very spiny; joints obovate, 2 to 4 dm. long, bright green when young, or sometimes slightly glaucous, grayish green in age; leaves subulate, small, reddish at top; spines at first 2 to 5, but in age 10 or more, when young reddish or pinkish at base and paler above, soon gray throughout, unequal, subulate, 4 cm. long or less; flowers at first yellow but soon orange to brick-red, rather large, 5 to 6 cm. long; petals few, about 10, oblong, retuse; filaments and style reddish; stigma-lobes pale green; fruit obovate to oblong, 4 to 5 cm. long, usually spiny, red, juicy, with a depressed umbilicus.

Fig. 294.—Opuntia soederstromiana.

Collected at San Antonio, Province of Quito, Ecuador, by J. N. Rose and George Rose, October 29, 1918 (No. 23559).

This plant was first collected for us by Ludovic Söderstrom of Quito, at the request of the President of the Central and South American Cable Company. Although great care was taken in shipping the plants they all died in transit. In 1918 Dr. Rose visited Mr. Söderstrom's locality and collected herbarium, living, and formalin material which has enabled us to describe the plant fully. The illustration here used was made at the same time.

Figure 294 is from a photograph of the type plant taken by George Rose.

161 *a*. Opuntia zebrina Small, Journ. N. Y. Bot. Gard. **20**: 35. 1919. (See page 155, *ante*.)

Plant erect, more or less branched throughout, fully 1 meter tall or less, the roots fibrous, joints oval or obovate, thickish, mostly 1 to 2 dm. long, deep green, sometimes obscurely glaucous; leaves ovoid, 2 to 3 mm. long, bright green; areloes scattered, some of them, usually the lower ones, unarmed, the upper ones irregularly armed; spines slender, solitary or 2, 3, or 4, together, red-brown, finely banded, nearly terete, closely spirally twisted; flowers few on a joint, or solitary; sepals deltoid to deltoid-reniform or nearly reniform; corolla yellow, rotate, 6 to 7 cm. wide; petals rather numerous, the inner ones broadly obovate, undulate, minutely mucronate or notched at the apex; berries obovoid, not constricted at the base, 3.5 to 4.5 cm. long, red-purple; seeds many, 6 to 7 mm. in diameter.

FIG. 295.—Opuntia zebrina.

Type locality: Middle Cape Sable, Florida.

Distribution: Coastal sand-dunes, Cape Sable, Florida, and the lower Florida Keys.

FIG. 296.—Fruit of O. zebrina. ×0.5.

The plant was first discovered by Dr. Britton on Boot Key, Florida, in 1909, and this is the most northern locality yet known for it. The species is interesting not only from its strikingly banded spines but also as being the only known member of the series *Elatiores* growing wild within the United States. In habit it resembles *O. dillenii*, and on Key West the two species were observed growing close together.

Illustration: Journ. N. Y. Bot. Gard. **20**: pl. 226.

Figure 295 is from a photograph of the plant on Cape Sable, Florida, in cultivation at Buena Vista, Miami, Florida; figure 296 shows a fruit collected by Dr. Rose on Key West, Florida, in 1918.

173 *a*. Opuntia keyensis Britton in Small, Journ. N. Y. Bot. Gard. **20**: 31. 1919. (See p. 162, *ante*.)

Plant erect, much branched, sometimes forming clumps 3 meters tall, with long fibrous roots; joints elliptic, oval, obovate, or spatulate, thick, 1 to 3 dm. long, bright green; leaves ovoid, 2 to 3 mm. long, green; areoles rather conspicuous, often relatively large and prominent, apparently unarmed; spines stout, 4 to 13 together, very short, mostly hidden in the bristles; at first pink, at maturity salmon-colored, slightly flattened; flowers solitary or 2 or 3 on a joint; sepals deltoid to subreniform, acute or acutish; corolla salmon-colored, cup-like, or short-campanulate, 3 to 3.5 cm. wide; petals rather few, thinner ones broadly obovate or orbicular-obovate, undulate, scarcely, if at all, mucronate; berries obovoid, 4 to 6 cm. long, purple; seeds numerous.

FIG. 297.—Opuntia keyensis.

Type locality: Boot Key, Florida.

Distribution: Hammocks, Florida Keys and Cape Sable.

Opuntia keyensis was first collected by Dr. Britton in 1909 on Boot Key, Florida. Plants brought subsequently by Dr. Small from the Keys to Buena Vista, Miami, and there observed by him under cultivation show the species to be distinct from either *O. dillenii* or *O. stricta*, with both of which it has been associated.

Illustration: Journ. N. Y. Bot. Gard. **20**: pl. 225.

Figure 297 is from a photograph of the plant in cultivation at Buena Vista, Miami, Florida; figures 298 and 299 show its flowers, collected by Dr. Small on Key Largo, Florida, in 1909. See also plate XXX, figure 1.

FIGS. 298 and 299.—Flower of Opuntia keyensis. ×0.5.

183*a*. **Opuntia bonplandii** (HBK.) Weber, Dict. Hort. Bois 894. 1898. (See page 168, *ante*.)

Cactus bonplandii Humboldt, Bonpland, and Kunth, Nov. Gen. et Sp. **6**: 69. 1823.

Plants tall, 2 to 4 meters high, open-branching; joints ovate to obovate, 2 to 3 dm. long, dull green; spines at first 2 to 7, pale yellow, acicular, 1 to 1.5 cm. long but soon falling off; flowers orange-colored, about 6 cm. long and nearly as broad when fully expanded; petals obtuse; stamens short.

Type locality: Cuenca, Ecuador.

Distribution: Ecuador.

This species was collected by Humboldt and Bonpland at Cuenca, Ecuador, and was first described as *Cactus* (*Opuntia*) *bonplandii*. Apparently the type was not pre-

served as Dr. Rose did not find it either at Berlin or Paris in 1912. Schumann mentions it only in a note under *O. quitensis* following Weber who associates the two. Dr. Rose, while in Ecuador in 1918, spent about a week at Cuenca collecting plants in all directions from the town. The only *Opuntia* in this whole region is the one above described which grows in hedges and along the roadsides. It may be an introduced species which has escaped from gardens but we know nothing in cultivation just like it. It resembles

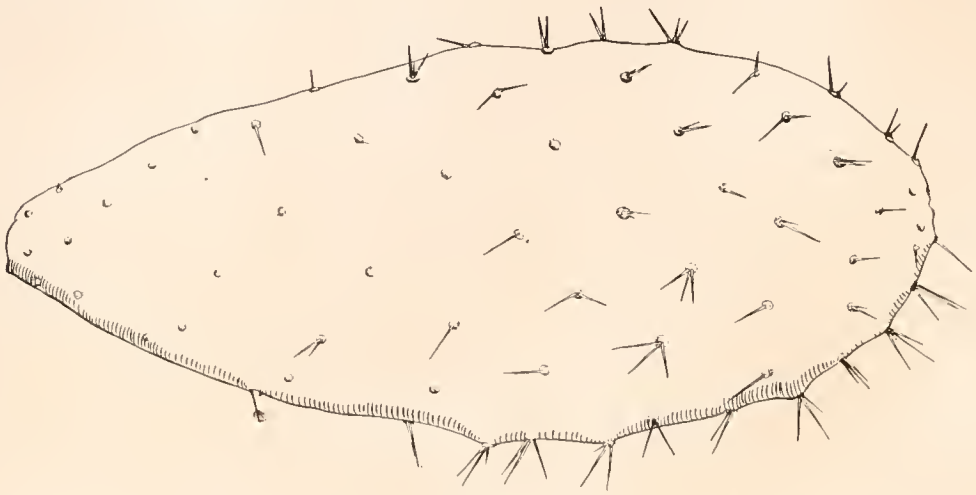


FIG. 300.—Opuntia bonplandii. ×0.5.

somewhat the Nopal de Castilla, so common in Mexico and the southwestern states Humboldt compared it with the tuna de Espana which may be the same. Bonpland seems to have called his plant *Cactus coccinellifer* which it very much resembles in the shape of the joints and in being spineless in age. If we are right in our interpretation of this species it has no close alliance with *O. quitensis* which Dr. Rose collected also; it has very small flowers with erect petals which are not readily affected by the sun as are those of *O. bonplandii* and most of the other species.

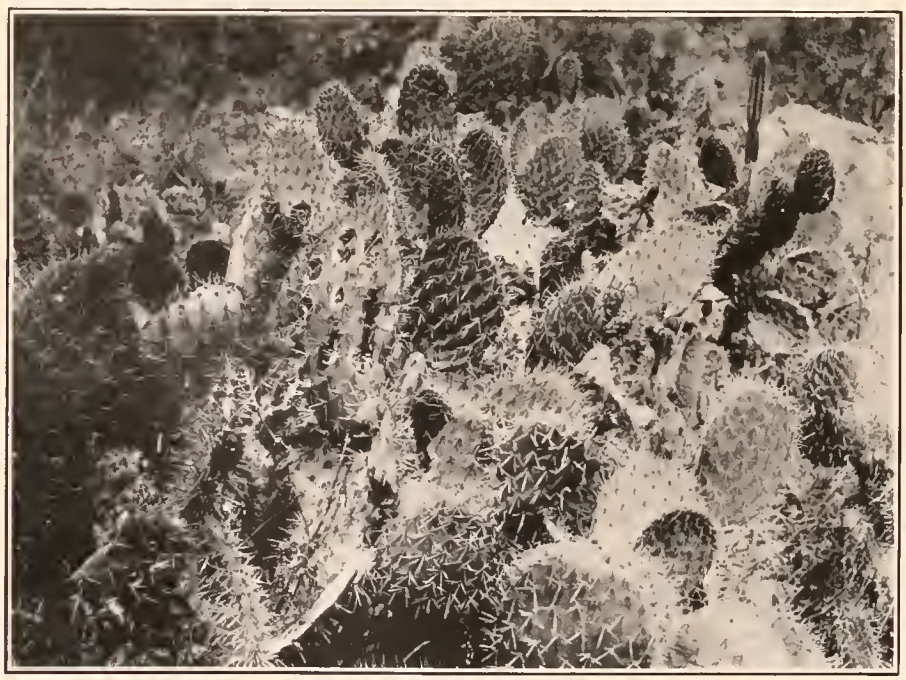


FIG. 301.—Opuntia dobbieana.

Figure 300 shows a joint collected by Dr. Rose at Cuenca, Ecuador, in 1918.

207 *a*. **Opuntia dobbieana** sp. nov. (See page 187, *ante*.)

Usually low and bushy, forming dense thickets, but sometimes tall and then 3 to 4 meters high; joints orbicular to short-oblong or obovate, 1 to 2.5 dm. long, pale green in color, very spiny; leaves minute, 1 to 2 mm. long, green, spreading; areoles small, closely set; spines white, 5 to 12, usually acicular but on old joints subulate, 1 to 3 dm. long, accompanied by 2 to 4 reflexed hairs from the lower side of the areole; flower, including ovary, 5 to 6 cm. long; petals chocolate-colored, oblong, 2 cm. long; filaments and style pinkish; stigma-lobes dull green; ovary strongly tubercled, leafy, very spiny, especially towards the top; fruit juicy, red, at first spiny, 3 to 5 cm. long.

Common in dry places from Huigra to Sibambe, Province of Chimborazo, Ecuador.

Collected by J. N. Rose and George Rose, August to November 1918, at Huigra (No. 22201, type); at Sibambe, August 29 (No. 22434).

This species, on account of its white spines, is referred to the *Streptacanthae*, although it usually is more bushy than these species generally are. So far as we could learn, the fruit is not used by the Ecuadoreans; the plant was never seen cultivated, and there is every reason to believe it is native to Ecuador.

The species is named for John Dobbie, general manager of the Guayaquil and Quito Railway, whose courtesies and assistance added greatly to the success of Dr. Rose's visit to Ecuador in 1918.

Figures 301 and 302 (the latter at the bottom of this page) are from photographs of the type plant, taken by George Rose.

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